Range Plant Communities and Range Health Assessment Guidelines for the

Foothills Fescue Natural Subregion of Alberta

Foothills Fescue

Range Plant Community Guide

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT
Public Lands

Publication No. T /038
ISBN: 0-7785-2836-7

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Citation for this document:

Adams, B.W., R. Ehlert, D. Moisey and R.L. McNeil. 2003. Rangeland Plant Communities and Range Health Assessment Guidelines for the Foothills Fescue Natural Subregion of Alberta. Rangeland Management Branch, Public Lands Division, Alberta Sustainable Resource Development, Lethbridge, Pub. No. T/038 85 pp.

RANGE PLANT COMMUNITIES AND RANGE HEALTH ASSESSMENT GUIDELINES FOR THE FOOTHILLS FESCUE NATURAL SUBREGION OF ALBERTA

Second Approximation

Pub. No. T/044

June 2003
Updated April 2005

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Executive Summary

The Foothills Fescue Natural Subregion is the moistest of the four Natural Subregions that make up the Grassland Natural Region. The Foothills Fescue is defined by Orthic Black Chernozemic soils with potential natural vegetation dominated by rough fescue, Parry oatgrass, Idaho fescue and wheatgrasses. Summer aridity and frequent winter Chinooks limit the persistence of woody species. Consequently, forest and shrub communities are limited to riparian areas and sheltered sites. The Foothills Fescue once occupied about 3.8 million acres in southwestern Alberta. Today about 16.8% of the original grassland landscape remains, primarily on commercial ranching operations where rough fescue is prized as a winter forage.

This, and other plant community guides in the series, replace the original Guide to Range Condition and Stocking Rates for Alberta Grasslands by Wroe et al. (1988). The guide is designed for use with the field workbook - Range Health Assessment for Grassland, Forest and Tame Pasture (Adams et al. 2003).

A new feature of this guide is a soil correlation mechanism that provides more guidance in determining range site, an important link to range plant communities. The guide should be used with published soil survey information or AGRASID (Agricultural Regions of Alberta Soil Information Database). Other site information like landscape, soil features and textural groupings will aid in range site determination.

A rich history of range research is reviewed from the Stavely Research Substation, managed by Agriculture and Agri-Food Canada. Past range plant community studies are also reviewed.

The analysis identified a total of 30 plant communities, 20 native grassland types, four modified grasslands and an additional six open shrub communities. Plant communities are reported in three categories. The reference plant communities are considered to represent the potential natural community for the site in question. Successional and modified plant communities are also identified in relation to the reference plant communities. These communities reflect the impact of variation in frequency and intensity of disturbance to the reference plant community. Suggested carrying capacities are provided for each plant community type.

Future studies will address riparian plant communities and other range sites of lesser extent on the landscape. The report also includes consolidated guidelines and scoring notes for range health assessment in the Foothills Fescue.

Acknowledgments

We wish to acknowledge Michael Willoughby, ASRD, Edmonton, for his leadership in the development of range plant community classifications for a significant portion of Alberta's rangelands. We also wish to express our sincere thanks for his council and assistance on methods and procedures. Mike Alexander, ASRD, Blairmore, John

Carscallen and Greg McAndrews, ASRD, Calgary, Alan Robertson (High Range Ecological Consultants), Varge Craig (Alta Rangeland Services Ltd.) and Tony Brierley (Agriculture and Agri-Food Canada) have contributed much to the review and refinement of this document and their assistance is greatly appreciated.

Development of plant community guides for the Grassland Natural Region has been possible because of large and growing body of high quality vegetation plot data collected by Range Management program staff and a number of rangeland consultants since 1986 when the Southern Range Inventory project was established, primarily to collect range plant community information for management planning. These professionals have payed particular care and attention to accurate plant taxonomy and consistent application of inventory methods. We wish to acknowledge the high quality of range vegetation inventory data that has been collected for the Public Lands Division by Kathy and Clare Tannas (Eastern Slopes Rangeland Seeds, Cremona, AB), Alan Robertson (High Range Ecological Consultants, Edmonton, AB) and Bryne Weerstra (Biota Consultants, Cochrane, AB).

Thanks to Dr. Walter Willms and Dr. John Dormaar, Agriculture and Agri-Food Canada for their friendship and constant encouragement. Thanks also to Francis Gardner, Gordon Cartwright and Jack Vandervalk for their years of patient teaching about foothill grasslands, their many values and management.

Comments on the Second Approximation

The second approximation adds an additional 10 plant communities to the original 20 in the first approximation. This classification provides an initial plant community guide to provide basic standards for assessing range health using the new range health assessment protocol (Adams et. al 2003). The first approximation guides in the Grassland Natural Region provide plant community information in a similar format to the plant community guides developed by Willoughby et. al (2003) for Boreal and Rocky Mountain natural regions thus ensuring a more standardized format province wide.

A new feature of guides in the Grassland Natural Region will be an improved framework for correlating soils information to range site and plant community. A strength of the original stocking guide (Smoliak et. al 1966, Wroe et. al 1988) was the use of generic range sites definitions that allowed users to recognize site potential. The new system builds on the old framework but provides more objectivity in determining range site.

Recently Thompson and Hansen (2002) have classified riparian and wetland plant communities in the Grassland Natural Region. The 3rd approximation of this guide will integrate their riparian plant community types as a new research project provides soil correlation guidelines for riparian landscapes in the Grassland Natural Region.

USING THE GUIDE - MAJOR TOPICS

Determining Ecological Range Sites

To use this plant community guide, you will need information about the dominant and co-dominant soils for the landscape you are interested in within the Foothills Fescue. Identification of the potential natural community (or reference plant community) for a site begins by recognizing the ecological range site. Range site is identified through **key attributes of the landscape**, of **soil features** and by **textural groupings**.
Important! - Review the reference materials identified in this chapter, especially AGRASID 3.0[1] (Agricultural Regions of Alberta Soil Information Data Base)

Chapter 2.0 provides a detailed review of physiography, climate and soils of the Foothills Fescue Natural Subregion:

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- General definitions for ecological range sites - Appendix 9.1..... page 74
- Correlation of soils and ecological range sites ..... page 10 - 13
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- Previous plant community studies in the Foothills Fescue .....page 22 - 24

Range Plant Communities (Reference, Successional and Modified) and Suggested Carrying Capacities

The KEY to range plant communities is on the following page.
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- Summary table of reference, successional and modified plant communities ..... page 28 - 31
- Summary of range plant communities and suggested carrying capacities

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[1] To obtain a copy of AGRASID 3.0 go to:
http://www.agric.gov.ab.ca/soil/agrasid/agrasidmainpage.html

Guidelines for Assessing Range Health in the Foothills Fescue Natural Subregion

Plant Community Categories

1. Native grasslands found in the Foothills Fescue ..... **Native Grassland Key**
   Plant communities are modified to non-native species or are shrub communities..... **2**
2. Plant communities dominated by non-native species like Kentucky blue grass, awnless brome and Timothy and/or weedy disturbance species ..... **Modified Grassland Key**
   Plant communities have more than 5% canopy cover of Willow, Common Rose or Ground Juniper ..... **Shrub Community Key**

Native Grassland Key

1. Native grassland is dominated[2] by rough fescue **2**
   Native grassland is dominated by Parry oatgrass, Idaho fescue, upland sedges, northern and western wheat grass or Kentucky bluegrass..... **8**
2. Native grassland is dominated by rough fescue and Parry oatgrass, with or without Idaho fescue.. ..... **3**
   Native grassland is dominated by rough fescue, Idaho fescue, Richardson's needle grass, or wheatgrasses with only minor amounts of Parry oatgrass..... **4**
3. Native grassland is dominated by rough fescue, and Parry oatgrass with or without Idaho fescue and is a loamy range site..... **Rough Fescue - Parry Oatgrass FFA5**
   Native grassland is dominated by rough fescue and Parry oatgrass with or without Idaho fescue and is a thin breaks or shallow-to-gravel/gravel range site. **5**
4. Native grassland is dominated by rough fescue and Parry oatgrass with or without Idaho fescue and is a thin break range site ..... **Rough Fescue - Parry Oatgrass - June Grass FFA17**
   Native grassland is dominated by rough fescue Parry oatgrass with or without Idaho fescue and is a shallow-to-gravel/gravel range site..... **Rough Fescue - Parry Oatgrass - Kentucky bluegrass FFA9**
5. Native grassland is dominated by rough fescue and Richardson needle grass and is a loamy range site on steep slopes (NOT thin breaks)..... **Rough Fescue - Richardson Needle Grass FFA23**
   Native grassland is dominated by rough fescue, Idaho fescue or wheatgrasses and; Parry oatgrass occurs in minor amounts or is absent..... **6**
6. Native rough fescue - Idaho fescue dominated grassland has been recently disturbed by drought or short term grazing impacts and shows a significant cover of disturbance species like fringed sage..... **Rough Fescue - Fringed sage - Idaho Fescue FFA3**
   Native grassland is dominated by rough fescue with Idaho fescue or northern and western wheatgrass as subdominant species **7**
7. Native grassland is a loamy range site dominated by rough fescue, Idaho fescue and upland sedges, Parry oatgrass is absent or in minor amounts ..... **Rough Fescue - Idaho Fescue - Sedge FFA2**

   Native grassland is dominated by rough fescue with Idaho fescue and/or wheatgrasses as subdominant species **7a**

7a. Native grassland is dominated by rough fescue and northern or western wheatgrass ..... **Rough Fescue - Northern and Western Wheatgrass FFA24**
   Native grassland is a loamy range site dominated by rough fescue, Idaho fescue and northern or western wheatgrass and is a loamy range site..... **Rough Fescue - Idaho Fescue - Western Wheat Grass FFA1**
8. Native grassland is dominated by Parry oatgrass and rough fescue..... **9**
   Native grassland is dominated by Idaho fescue, upland sedges, northern or western wheat grass, green needle grass or Kentucky bluegrass..... **11**

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[2]Dominated is defined as species that forms the highest percent cover, or higher than other associated individual species.

9. Native grassland is dominated by Parry oatgrass and rough fescue and is a loamy range site .....
.....**Parry Oatgrass - Rough Fescue - Kentucky Bluegrass FFA6**
Native grassland is dominated by Parry oatgrass and rough fescue and is a thin breaks or gravel/shallow-to-gravel range site.....10
10. Native grassland is a thin breaks range site.....
.....**Parry Oatgrass - Rough Fescue - Western Porcupine grass FFA18**
Native grassland is a gravel/shallow-to-gravel range site.....
.....**Parry Oatgrass - Rough Fescue - Idaho Fescue FFA10**
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Native grassland is dominated by upland sedges, northern or western wheatgrass, Idaho fescue or green needle grass 12
12. Native grassland is dominated by upland sedges and fringed sage.....
.....**Upland Sedges - Fringed Sage - Kentucky Bluegrass FFA4**
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13. Native grassland is dominated by Idaho fescue and rough fescue.....
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Native grassland is dominated by northern or western wheatgrass with green needle grass or western porcupine grass as the major subdominant species.....17
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17. Native grassland is dominated by northern or western wheatgrass with green needle grass as the major subdominant ....**Northern and Western Wheatgrass - Green Needle Grass FFA27**
Native grassland is dominated by northern or western wheatgrass with western porcupine grass as the major subdominant..... .....**Northern Wheat Grass - Western Porcupine Grass - Junegrass FFA14**

Modified Grassland Key

1. Modified grassland community is dominated by awnless brome.....**Awnless Brome - Alfalfa FFB3**
Modified grassland community is dominated by Kentucky bluegrass.....2
2. Modified grassland community is dominated by Kentucky bluegrass with awnless brome and native wheatgrasses as a subdominant species.....
.....**Kentucky Bluegrass - Awnless Brome - Northern and Western Wheatgrass FFB4**
Modified grassland community is dominated by Kentucky bluegrass with Timothy or fringed sage as subdominant species.....3
3. Modified grassland is dominated by Kentucky bluegrass and Timothy.....
..... **Kentucky Bluegrass - Timothy FFB1**
Modified grassland community is dominated by Kentucky bluegrass and and fringed sage
.....**Kentucky Bluegrass - Fringed Sage FFB2**

Shrub Community Key

1. Shrub community is a wetland or sub-irrigated range site with beaked willow and other willows being the principal shrub species at between 5 and 15% canopy cover.....2
Shrub community is an upland range site with more than 5% canopy cover of common wild rose, snowberry or ground juniper.....3

2. Plant community is dominated by beaked willow, sedges and tufted hair grass.....
.....**Beaked Willow/Sedge - Tufted Hair Grass FFC2**
Plant community is dominated by invasive agronomic species like Kentucky bluegrass, Timothy and awnless brome .....**Beaked Willow/Kentucky Bluegrass -Timothy - Tufted Hair Grass - FFC3**

3. Range site is a thin breaks type and plant community is dominated by ground juniper **5**
Plant community is dominated by common wild rose or western snowberry **4**

4. Plant community is a highly disturbed plant community with grazing resistant shrubs like common wild rose and invasive and weedy species like Kentucky bluegrass, Timothy and dandelion.....
.....**Common Wild Rose/Kentucky Bluegrass - Dandelion FFC1**
Plant community is a limy range site on cool north or east facing slopes and is dominated by western snowberry ..... **Snowberry/ Awnless Brome FFC5**

5. Shrub community is dominated by ground juniper and Parry oatgrass .....
.....**Creeping Juniper/Parry Oat Grass - Western Porcupine Grass FFC4**
Shrub community is dominated by ground juniper and northern and western wheatgrass .....
.....**Creeping Juniper/Northern and Western Wheatgrass FFC6**

1.0 Introduction and Background

1.1 This guide is an aide to range health assessment

This plant community guide is provided as an essential reference for range health[3] assessment in the Foothills Fescue prairie. Range health assessment (Adams et al. 2003) is a new approach that builds on the traditional range condition concept that considers plant community type in relation to site potential, but also adds new indicators of important natural processes and functions.

Range management strives to protect and enhance the soil and vegetation complex while maintaining or improving the output of consumable products along with a wide range of other values and natural functions. Ranchers and resource managers have used the concept of range condition in Alberta to measure any deterioration that has taken place within a range plant community due to disturbances, especially those from livestock grazing. Range condition has been rated in relation to a concept of site potential or climax vegetation. The first stocking guide for the Grassland Natural Region The Guide to Range Condition and Stocking Rates for Alberta Grasslands, was patterned after the US Department of Agriculture - Soil Conservation Service "range site" concept (Smoliak et al 1966, Wroe et al 1988). Since the first guide was published, several generations of ranchers and range resource managers have developed an understanding of range sites and the ecological conditions that they represent. The new range health tools are similarly intended for use by range resource managers and ranchers and for a wide variety of other groups and users that share an interest in healthy rangelands.

Range managers generally strive to maintain plant communities at or near the climax or potential natural community (PNC) stage in order to provide higher levels of ecological functioning and to sustain an optimum flow of products like livestock forage. Healthy range plant communities perform important ecological functions and provide a broader suite of goods and services than lower seral stages. Early and mid seral stages need to be present in the landscape to represent the full range of natural variation that existed prior to European settlement, but should not be predominant.

Our use of the term "range health" instead of "range condition" flags a change in approach that builds on the traditional range condition approach that considers plant community type in relation to site potential, but also adds new indicators of important natural processes and functions, important functions performed by healthy rangelands. We use the term range health to mean the ability of rangeland to perform certain ecological functions. These functions include:

- net primary production,

[3]The range health approach is being adopted in the United States and Canada by a variety of agencies and organizations including the Natural Resource Conservation Service (NRCS), the US Forest Service and the Bureau of Land Management (Butler et al 1997, Busby et al 1994, and Task Group on Unity in Concept and Terminology 1995). The Alberta Rangeland Health Assessment project will provide new rangeland monitoring tools for Alberta rangelands (Alberta Range Health Task Group 1999).

- maintenance of soil/site stability,
- capture and beneficial release of water,
- nutrient and energy cycling and,
- plant species functional diversity.

Healthy rangelands will provide sustainable grazing opportunities for livestock producers and also sustain a long list of others products and values. Declines in range health will alert the range manager to the need for management changes.

1.2 Ecological Range Sites and Grassland Plant Communities

Range health is measured by comparing the functioning of ecological processes on an area of rangeland to a standard known as an **ecological site description**. An **ecological site** is similar to the concept of **range site**, but a broader list of characteristics are described. *An ecological site as defined by the Task Group on Unity and Concepts (1995), "is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation".* This is similar to the ecosite/ecosite phase concept described by Archibald and Beckingham (1996) largely applied in the forested portions of the Rocky Mountain, Foothills and Boreal Forest Natural Regions where forest cover provides a valuable aide to community classification.

Ecological classification systems are an important tool for resource managers (Archibald and Beckingham 1996, Willoughby et. al 2003) and they:

- help us to organize what we know about ecosystems,
- provide resource managers with a common language for range resource management and planning,
- facilitate ecologically based decision making,
- help us to understand and refine resource potentials and carrying capacities over time.

Early grassland studies in the 1940's and 1950's (Clark et. al 1943, Coupland 1950, 1961) provided a broad and generalized understanding of prairie grassland communities, but a comprehensive classification of Alberta Grassland Natural Region has never been completed. An ecological classification system must provide a method for identifying site potential and to help predict where a particular plant community is likely to occur in the landscape. In a forest setting, forest canopy provides important evidence of growing conditions and site potential. In grassland environments, soils information is essential to predicting the potential natural community, especially where disturbance history may limit the resource manager's understanding of the ecological status of the current plant community vs. the potential for the site. **In range health assessment, we refer to the plant community that is an expression of site potential as the reference plant community (RPC) since this is the community that acts as a standard for comparison.**

With the development of AGRASID (Agricultural Region of Alberta Soil Inventory Database, ASIC 2001), it is possible to establish site and soil characteristics within an acceptable degree of accuracy from the AGRASID for lands in the agricultural settlement area of the province. The soil/range site correlation tables developed by LandWise Inc. (1998, 2001) provide a crosswalk that allows users to apply information about soils and other landscape variables to establish range sites. Range site descriptions are used to predict reference plant communities in the current project.

Grassland plant communities are defined in an ecological classification system in a similar fashion to forest communities by grouping vegetation data (from research plots and range surveys) "into similar functional units that respond to disturbance in a similar and predictable manner (Archibald and Beckingham 1996)". An important part of this classification process is to correlate the plant communities with recognizable range sites in the prairie landscape. The plant communities presented in this project represent the first approximation for the soil correlation areas (SCAs) and Natural Subregions in question and will be further revised and refined when additional vegetation survey data becomes available.

2.0 Physiography, Climate and Soils of the Foothills Fescue Grassland

2.1 Overview[4]

The Foothills Fescue Natural Subregion is one of four Natural Subregions in the Grassland Natural Region, along with the Dry Mixedgrass, Mixedgrass and Northern Fescue (Fig. 1). The Foothills Fescue accounts for 1.95 % of the area of Alberta and it covers 13.45% of the Grassland Natural Region (ASIC, 2001). The boundaries of Natural Subregions correspond closely to the boundaries of the Agricultural Regions of Alberta Soil Information Database (AGRASID) Soil Correlation Areas (SCAs) (ASIC 2001). The Foothills Fescue Natural Subregion is correlated with SCA 5 in the south (Del Bonita through Cardston to the Pekisko area), and with SCA6 in the north (Stavely north to Crossfield and Trochu). We estimate that about 16.8% of the original grassland area of the Foothills Fescue is still intact, most of which is located in SCA 5 (Fig. 2 - in green).

The Foothills Fescue Natural Subregion occurs along the lower and eastern flanks of the Foothills Geologic Belt. The Foothills Fescue displays a wide range of physiography due to variation in glaciation and bedrock topography. Elevations in the Foothills Fescue are much higher than in the other grassland subregions (Achuff 1994), but lower than in the Foothills Parkland to the west. The Foothills Fescue Natural Subregion includes four Ecodistricts[5] (Fig. 2). From south to north they are: a highland area on the Milk River Ridge named the **Del Bonita Plateau**, the **Cardston Plain**, the **Willow Creek Upland**, which occurs at lower to mid elevations on the flanks of the Porcupine Hills, and the

[4] For a detailed description of physiography, climate and soils of the Grassland Natural Region, see LandWise Inc. (2003).

[5] Ecodistricts are based on distinct physiographic and/or geologic patterns. They are distinguished by similar patterns of relief, geology, geomorphology and genesis of parent material.

Delacour Plain, which is entirely on the plains. Two small isolated occurrences of Foothills Fescue also occur within the Mixedgrass Natural Subregion between Mossleigh and Milo (**Buffalo Hill Upland**), where elevations are higher than on the surrounding plains (Fig. 2). The Foothills Fescue is also presented in relation to adjoining Natural Subregions (Fig. 3).

Fig. 1. Foothills Fescue Natural Subregion in relation to soil correlation areas 5 and 6.

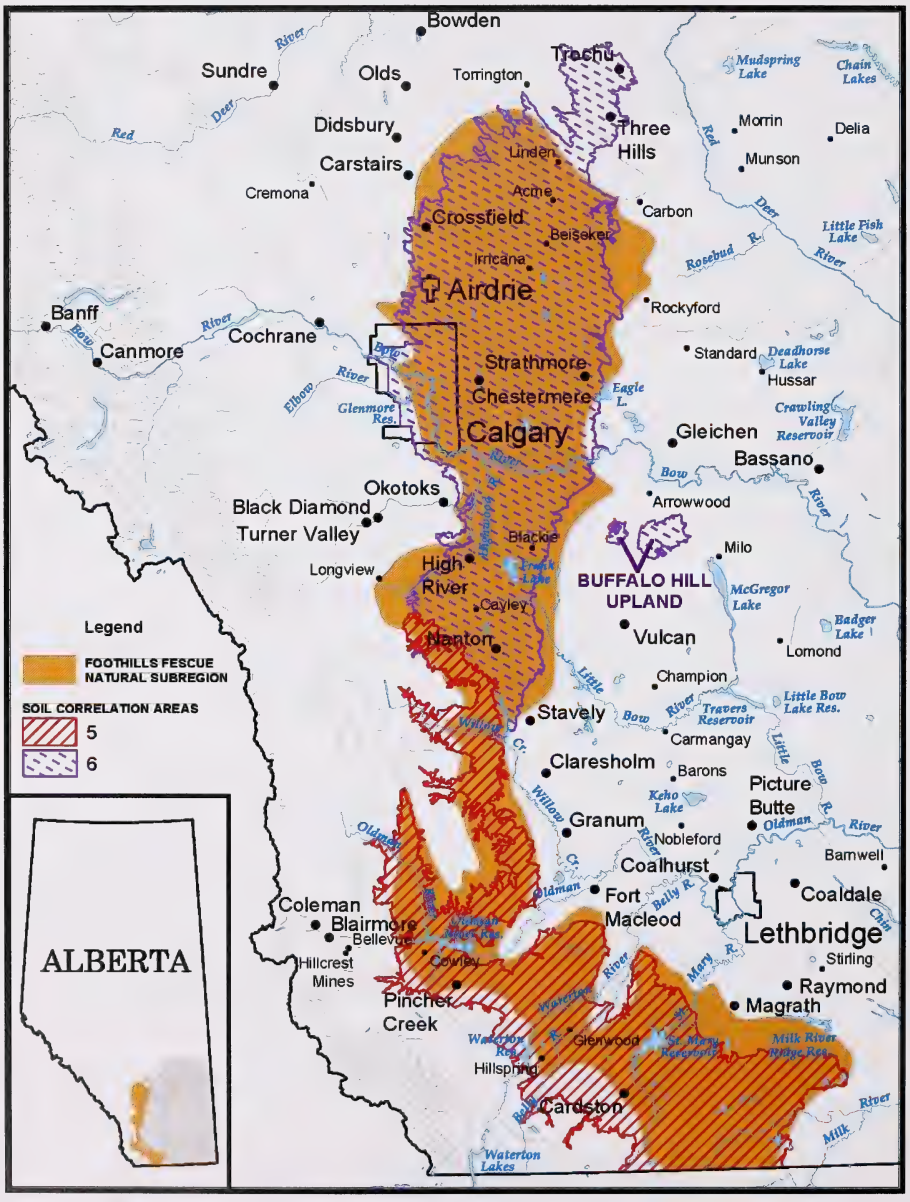


Figure 1: Foothills Fescue Natural Subregion in Relation to Soil Correlation Areas 5 and 6

Fig. 2. Ecodistricts in the Foothills Fescue, and the Buffalo Hill Upland areas.

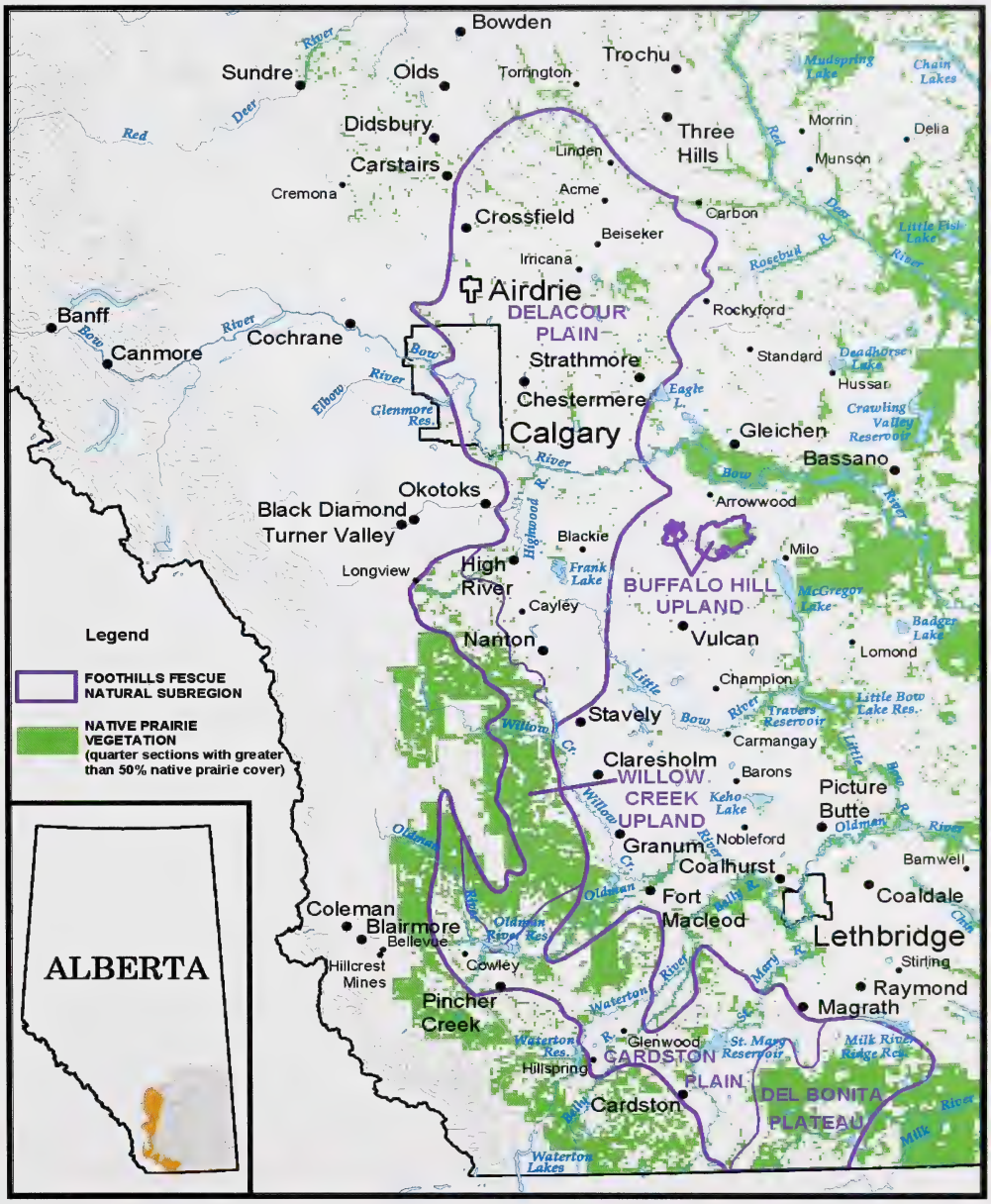


Figure 2: Ecodistricts in the Foothills Fescue Natural Subregion, and the Buffalo Hill Upland

Fig. 3. Foothills Fescue, and the Buffalo Hill Upland areas, and adjoining Natural Subregions in SW Alberta.

Figure 3: Foothills Fescue Natural Subregion with Hillshade Model (Digital Elevation Model)

The climate in the Foothills Fescue Natural Subregion is characterized by short summers with warm days and cool nights, and long cold winters, similar to the climate throughout southern Alberta. However, winter temperatures in the Foothills Fescue Natural Subregion are moderated by frequent chinook winds, which are strong westerly winds that occur most frequently in late fall and winter. The adjoining Mixed Grass Natural Subregion (Table 1), is drier, warmer in summer and has less intense Chinooks. To the west the Foothills Parkland is cooler and moister.

Table 1. Key distinguishing features of the Foothills Fescue Natural Subregion compared with neighboring Natural Subregions.

Natural Subregion	Dominant Soils	Dominant Vegetation	General Climate Compared to Foothills Fescue
Foothills Fescue	Black Chernozem	Foothills rough fescue	winter climate moderated by Chinooks, high frequency of snowfall in late winter and early spring (Achuff 1994)
Mixed Grass	Dark Brown Chernozem	Wheatgrasses and spear grasses	drier, warmer summers, less intense Chinooks
Foothills Parkland	Black Chernozem (Thick)	Foothills rough fescue, shrubs and aspen forest	cooler and moister
Northern Fescue	Dark Brown Chernozem and Dark Brown Solonetz	Plains rough fescue and Porcupine grass	colder, more continental, drier and fewer Chinooks
Central Parkland	Black Chernozem	Plains rough fescue, shrubs and aspen forest	colder with significantly fewer Chinooks

Mean annual precipitation in the Foothills Fescue ranges from about 397 mm at Del Bonita to 589 mm at Pincher Creek. The Cardston Plain receives more precipitation than the other three Ecodistricts (Table 2) due to its proximity to the Rocky Mountains and the higher frequency of snowstorms in late winter and early spring. The Foothills Fescue overall receives more snowfall in late winter and early spring than does the Northern Fescue Subregion (SCA4) (Achuff 1994).

Mean daily temperature in the Foothills Fescue ranges from 3.8°C at Whiskey Gap and High River, to 5.4°C at Cardston (Table 2). Cardston is highly influenced by chinooks, in

addition to experiencing warmer summers than the Milk River Ridge (Del Bonita Plateau) to the east and the Foothills Fescue north (SCA6). Mean daily temperatures have risen about 0.5°C between the earlier recording period (1951 to 1980) and the more recent period (1971 - 2000) (Table 2). The increases at Calgary and High River may at least partially reflect the rapidly growing urban area.

A ninety day frost-free period has been considered a diagnostic value for the higher elevation areas of the Foothills Fescue. The frost-free period for the Milk River Ridge Upland was reported as less than 90 days by Kjearsgaard et al. (1986), consistent with the 88-day Climate Normal value for Whiskey Gap. It is assumed that the mean daily temperature and the frost-free period in the Willow Creek Upland is more similar to the Del Bonita Plateau than to the Cardston Plain, although the only recorded data is precipitation at Claresholm/Meadow Creek, at an elevation of 1052 m.

Table 2. Summary of climatic data for selected stations in the Foothills Fescue Natural Subregion

Ecodistrict	Station and Elevation in meters	Mean Daily Temp. (°C)	Total precip. (P) (mm)	Mean precip. as rain (%)	% of ppt. from May to Sept.	[Z](P-PE) (mm)	Effective Growing Degree Days (EGDD > 5°C)	Frost-free period (days (>0°C)
Del Bonita Plateau	Del Bonita	[Y]4.3	397	76			1390	
	Whiskey Gap	3.8	452	61			1321	88
Cardston Plain	Cardston, 1193	[X]4.8 (5.4)	550 (557)	58 (61)	(58)		1543 (1579)	111
	Pincher Creek Town	[W]4.1	589	59			(1396)	106
Willow Creek Upland	Claresholm /Meadow Creek, 1035		444	67	61			
Delacour Plain	Calgary Int. Airport, 1084	3.6 (4.1)	423 (413)	(78)	70 (76)	-204	1281 (1431)	113
	Trochu-Equity, 854	3.5	419	74	68		(1578)	

[Z] Precipitation – Potential Evapotranspiration

[Y]Values without brackets are compiled from Atmospheric Environment Service (1951 – 1980 Normals), and most are published in Brierley et al. (1991), MacMillan et al. (1987).

[X]Values in brackets are Canadian Climate Normals for the 1971 – 2000 period (From www.msc-smc.ec.gc.ca/climate/climate_normals/results

[W]Values are published in Walker et al. (1991).

The Foothills Fescue Natural Subregion is dominated by Black Chernozemic soils (Table 3). Parent materials are dominantly glacial till, an unsorted mixture of sand, silt and clay deposited directly from the ice. Glacio-lacustrine deposits are the next most common where silt and clay have settled from suspension from ice-marginal glacial lakes. Glacial fluvial (outwash) sediments occur in glacial meltwater channels, in middle and upper terraces of major creeks and river valleys. These deposits are often composed of greater than 20% gravel and cobbles, within a coarse matrix of loamy sand and sand, in lenses or bands. Residual and fluvial-aeolian parent materials have a minor occurrence in the subregion. Topography is dominantly undulating, but hummocky, inclined, level, rolling and ridged areas also occur. Drainage is dominantly north to the South Saskatchewan River drainage, but a drainage divide occurs on the north escarpment of the Milk River Ridge, and the drainage to the south flows to the Missouri River system.

The level and undulating areas of the Foothills Fescue Natural Subregion are largely devoted to crop agriculture. Upland areas, including the Willow Creek Upland and the Del Bonita Plateau, are dominated by native vegetation and are used for livestock grazing.

2.2 Correlation of Soils and Range Sites

The major soil series and their associated range sites for each Ecodistrict in the Foothills Fescue Natural Subregion are summarized in Table 3. LandWise Inc. (1998, 2001) developed soil correlation guidelines to link soils and site to ecological range site types. A complete listing of ecological range site types can be found in Appendix 9.1.

- Soil correlation guidelines to range sites for SCA 5 and 6 can be found in Tables 4 and 5 on pages 12 and 13. You can use AGRASID 3.0 or a published soil survey report to determine the dominant and co-dominant soils for the site you wish to evaluate. Use the soil series name or three letter name abbreviation to determine range site.
- Range site can also be determined using the range site descriptions in section 2.3 on pages 14-17.
- **See Appendix 9.2 A Concise Guide to Assist Users of AGRASID**

Major Soil Orders and Great Groups in the Foothills Fescue Natural Subregion

Black Chernozemic soils dominate in the Foothills Fescue Natural Subregion. Chernozemic soils are well- to imperfectly-drained soils that have developed under grassland communities. They are characterized by a dark-coloured surface (A) horizon that is at least 10 cm thick, resulting from the accumulation of debris and decomposition of organic matter derived from grasses and forbs. The A horizon of Black Chernozems has a colour value darker than 3.5 moist and dry. Chroma is usually 1.5 or less dry. The soil climate is sub-humid. An important distinction also includes Ah horizon thickness. In the Foothills Fescue, Ah horizons normally are less than 20 cm in thickness on an average slope position, and hence, are loosely termed Orthic Black soils. Thick Black Chernozems predominate in the Foothills Parkland (Table 1) where growing conditions are cooler and moister.

Regolosolic soils occur to a minor extent. Regosols lack a B horizon greater than 5 cm and may also be characterized by a shallow A horizon. Regosols are weakly developed soils for many reasons, which can include development on young geologic materials (flood plains), or in unstable locations such as steep slopes, active flood plains or locations prone to wind erosion.

Brunisolic soils are also of relatively minor extent in the Foothills Fescue Natural Subregion, but they occur where shallow parent materials overlie sandstone bedrock, or with weathered sandstone. Brunisolic soils lack a Chernozemic A horizon, and are usually characterized by an Ah less than 5 cm thick. Brunisolic soils represent an intergrade between Regosolic and Chernozemic soils.

Solonetzic soils contain a high proportion of sodium in the subsoil and they are characterized by a hardpan layer in the subsoil that is massive and hard when dry, and impervious and very sticky when wet. They are usually associated with areas of former saline and sodic groundwater discharge, but they can also occur where sodium rich bedrock material occurs at or near the soil surface. The limited occurrence of Solonetzic soils in the Foothills Fescue Natural Subregion is normally associated with discharge areas where sodium salts have influenced soil development.

Gleysols are subject to periodic flooding or prolonged wetting, and typically lack oxygen

during a portion, or most, of the growing season. Gleysols are often nutrient poor due to denitrification, and because decomposition is hindered by wetness. Gleysols are representative of seasonal to semi-permanent wetlands.

Table 3. Major soils and associated ecological/range sites, by Ecodistrict or area.

Ecodistrict or Area	Major Soil Series	Soil Subgroup	Parent Material	Ecological/Range Site
Del Bonita Plateau, glaciated portion	BZR (Beazer)	Orthic Black Chernozemic	glacial till	Loamy (Lo)
	RFD (Rockford)	Orthic Black Chernozemic	gravelly medium glaciofluvial	Shallow to Gravel (SwG)
	OKY (Ockey)	Orthic Black Chernozemic	till veneer over bedrock	Thin Breaks (TB)
Del Bonita Plateau, unglaciated portion	DLB (Del Bonita)	Orthic Black Chernozemic	loess	Loamy (Lo)
	HLM (Hillmer)	Orthic Black Chernozemic	medium slope-wash fans	Loamy (Lo) on higher elevations; Overflow (Ov) on lower elevations
Cardston Plain	CTN (Cardston)	Orthic Black Chernozemic	fine glaciolacustrine	Clayey (Cy)
	CWY (Cowley)	Calcareous Black Chernozemic	fine glaciolacustrine	Limy (Li)
	BZR (Beazer)	Orthic Black Chernozemic	glacial till	Loamy (Lo)
	NNK (Ninastoko)	Black Solodized Solonetz	glacial till	Blowouts (BlO)
	OKY (Ockey)	Orthic Black Chernozemic	till veneer over bedrock	Thin Breaks (TB)
Willow Creek Upland	BZR (Beazer)	Orthic Black Chernozemic	glacial till	Loamy (Lo)
	OKY (Ockey)	Orthic Black Chernozemic	till veneer over bedrock	Thin Breaks (TB)
	NFK (North Fork)	Orthic Eutric Brunisolic	till veneer over bedrock	Thin Breaks (TB)
	PSO (Parsons)	Rego Black Chernozemic	glacial till	Limy (Li)
	ODM (Oldman)	Rego Black Chernozemic	coarse glaciofluvial	Limy (Li)
Buffalo Hill Upland	ADY (Academy)	Orthic Black Chernozemic	glacial till	Loamy (Lo)
Delacour Plain	ADY (Academy)	Orthic Black Chernozemic	glacial till	Loamy (Lo)
	RKV (Rockyview)	Orthic Black Chernozemic	medium glaciolacustrine veneer over till	Loamy (Lo)
	DEL (Delacour)	Orthic Black Chernozemic	glacial till	Loamy (Lo)
	MDP (Midnapore)	Orthic Black Chernozemic	moderately coarse glaciofluvial	Sandy (Sy)
	ARE (Ardenode)	Orthic Black Chernozemic	very coarse fluvial/eolian	Sand (Sa) and Choppy Sandhills (CS)
	LTA (Lyalta)	Orthic Black Chernozemic	medium glaciolacustrine blanket	Loamy (Lo)
	KYN (Kathyrn)	Saline Gleyed Black Chernozemic	medium glaciofluvial veneer over till	Saline Lowland (SL)
	KEO (Keoma)	Gleyed Black Solodized Solonetz	moderately-fine glaciofluvial veneer over till	Blowouts (BlO)

Table 4. Soil correlation with ecological range sites in SCA 5, Black Soil Zone, SW Alberta, Foothills Fescue Natural Subregion.

Productivity Rating	Ecological/Range Site	Soil or Landscape Description	[Z]Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**HLM, LVY, SND**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	JAT, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (refer to Fig. 4)	CTN, PNR, **SND, CWY**
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (refer Fig. 4)	BUL, BZR, DLB, **HLM, ODM, OWD, RFD**, SAK, SOF
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures (refer to Fig. 4)	KNT, **LVY**
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	CGE, KGT, NNK, **OXY**, PGN, MAM
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (refer to Fig. 4)	
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	RND
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	**CWY, MKN, ODM,** PSO, ZER, [Y]WOLaa
	Saline Lowlands (SL)	Saline discharge; salt-enriched	ZNA
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	BFT, **RFD**
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	**MKN**, NFK, OKY, **OWD, OXY**

[Z]For a complete description of soil series attributes please refer to the Soil Names file in AGRASID 3.0 (www.agric.gov.ab.ca/asic). [Y] aa: indicates soil series that occur mainly in a bordering SCA, with only a small area in this SCA. Note: Soil series codes in bold occur in more than one ecological/range site.

Table 5. Soil correlation with range sites in SCA 6, Black Soil Zone of SW Alberta, Foothills Fescue Natural Subregion.

Productivity Rating	Ecological/Range Site	Soil or Landscape Description	[Z]Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**KEO**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	**KEO, KYN**
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	DWT, IND, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (Refer to Fig. 4)	THH, TWG
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (Refer to Fig. 4)	ADY, DEL, LTA, RKV, [Y]SAKaa
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures (Refer to Fig. 4)	**HPV**, MDP
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and generally <1m deep; AGRASID landscape models include I4, I4m and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	BED, **KEO**
	Choppy Sandhills (CS)	Duned landscape models; very coarse textures (VC) (Refer to Fig. 4)	**ARE**
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	BOV
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	EBO, **HIW, HPV**, [Y]NSKaa, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	BZC, GAY, **KYN**, ZNA
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	**ARE, HIW**
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	RSB
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	[Y]HFDaa

[Z]For a complete description of soil series attributes please refer to the Soil Names file in AGRASID 3.0 (www.agric.gov.ab.ca/asic).

[Y] aa: indicates soil series that occur mainly in a bordering SCA, with only a small area in this SCA.

Note: Soil series codes in bold occur in more than one ecological/range site.

2.3 Guidelines for Determining Range Sites

Ecological Range Sites in the Foothills Fescue Natural Subregion

Ecological/range sites in the following guidelines are divided into three groups based on their main defining feature of landscape, soil or texture.

Group 1 Ecological Range Sites Defined Mainly by Landscape

Badlands/Bedrock (BdL):

Applies to all inclined to steeply sloping landscapes with greater than 10% bedrock exposures of softrock or hardrock. Slopes generally range from 15% to 60% (in isolated cases 7% to 100%). Includes I4m, I4h and I5 landscape models from AGRASID 3.0.

Overflow (Ov):

Applies to non-saline Chernozemic (soils with A, B and C horizons) and/or Regosolic soils (soils that lack a B horizon >5 cm thick, and may lack an A horizon) on landscapes that are low-relief inclines in valley or basinal settings. Overflow sites are usually fan or apron deposits, where upslope streams enter lowland areas and experience a marked decrease in gradient. Slopes generally range from 2% to 9% (in isolated cases from 0.5% to 15%). Overflow occurs only on lower slope positions or adjacent to stream(s), and the percentage of eligible overflow ranges from 10% to 50% per SLM (specific rules within each SCA). Overflow includes I3l and I4l landscape models from AGRASID 3.0, and also applies to the soil series Hillmer (HLM) and Shandor (SND) in SCA5.

Riparian (Ri):

Applies to all stream channels and flood plains. Includes FP1, FP2, FP3, SC1-l, SC1-h, SC2, SC3 and SC4 landscape models from AGRASID 3.0. True riparian areas only include the valley floor (from bottom of bank to bottom of bank on the other side of the valley).

Thin Breaks (TB):

Applies to: 1) all steeply-sloping landscapes with less than 10% bedrock exposures; 2) to largely vegetated areas with bedrock at or near (within 5 m of) the surface; 3) the soil series Mokowan (MKN), North Fork (NFK), Ockey (OKY), Owendale (OWD) and Oxley (OXY).

Group 2. Ecological/Range Sites Defined Mainly by Soil Features

Blowouts (BlO):

Applies to all SLMs where soils from the Solonetzic order are dominant (>50%) or co-dominant (30 to 50%). Solonetzic soils have an impervious hardpan layer (Bnt horizon) in the subsoil that is caused by excess sodium (Na+). The land surface is frequently characterized by eroded pits. Applies to the soil series Crowlodge (CGE), Klemengurt (KGT), Ninastoko (NNK), Piegan (PGN), Mami (MAM), Beddington (BED) and Keoma (KEO), and also applies to undifferentiated Solonetz (ZSZ).

Limy (Li):

Applies to all immature or eroded soils with free lime (calcium carbonates) at the soil surface or in the B horizon. Free lime is detected by effervescence when soil is treated with 10% hydrochloric acid (HCl). Limy soils include Rego or Calcareous Chernozemics, eroded phases, and subgroups from the Regosolic order if they are calcareous. Applies to the soil series Cowley (CWY), Mokowan (MKN), Oldman (ODM), Parsons (PSO), Elbow (EBO), Highwood (HIW) and Happy Valley (HPV).

Sub-irrigated (Sb):

Applies to all Gleyed, non-saline, medium to very coarse textured soils. Gleyed soils occur where the water table occurs near the soil surface, but does not often occur above the soil surface. Gleyed subgroups have faint to distinct mottles within 50 cm, or prominent mottles between 50 and 100 cm.

Saline Lowland (SL):

Applies to all salt-enriched soils, including Saline phase Chernozemic, Saline phase Regosolic, and Saline phase Gleysolic soils. Saline phase soils have an electrical conductivity greater than 4.0 dS/m, which retards most plant growth. Applies to the soil series Balzac (BZC), Gayford (GAY), and Kathyrn (KYN), and also applies to undifferentiated saline soils (ZNA).

Wetlands (WL):

Applies to all non-saline or weakly-saline of the Gleysolic and Organic orders. Gleysolic soils occur in seasonal to semi-permanent wetlands. They are typified by dull colours or prominent mottles with 50 cm due to prolonged periods of intermittent or continuous saturation, and the lack of oxygen in the soil. Organic soils are dominated by the accumulation of decomposing peat material derived mainly from sedges and reeds. Applies to the Gleysolic soil series Joanto (JAT), Dewinton (DWT), and Indus (IND), and also applies to undifferentiated wet soils (ZGW).

Group 3 Ecological/Range Sites Defined Mainly by Textural Groupings

Soils are made up of varying components of sand, silt and clay, with the sum of the three equal to 100% (Fig. 4, the soil textural triangle). Soils may also include particles larger than 2.0 mm, or coarse fragments (Table 6).

Table 6. Definition of soil particle sizes.

Category	Particle	Diameter (mm)
Components of soil texture	clay	<0.002
	silt	0.002 to 0.05
	sand	0.05 to 2
Coarse fragments	gravel	2 to 75
	cobbles	75 to 250
	stones	250 to 600
	boulders	>600

Clayey (Cy):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the fine or very fine (E.g., clay and silty clay) textural subgroups (>40% clay, Fig. 4). Applies to the soil series Cardston (CTN), Pincher (PNR), Shandor (SND), Three Hills (THH), and Twining (TWG).

Loamy (Lo):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the medium and moderately fine textural subgroups (E.g., loam and clay loam, Fig. 4). Applies to the soil series Academy (ADY), Bullhorn (BUL), Beazer (BZR), Delacour (DEL), Del Bonita (DLB), Hillmer (HLM), Lyalta (LTA), Rockyview (RKV), Sakalo (SAK), and Standoff (SOF).

Sandy (Sy):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the moderately coarse (sandy loam) textural subgroup (Fig. 4). Applies to the soil series Knight (KNT), Lonely Valley (LVY), and Midnapore (MDP).

Sands (Sa):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the very coarse (loamy sand)

textural subgroup (Fig. 4). Sa does not apply to duned landscapes. Applies to the soil series Ardenode (ARE) and Highwood (HIW).

Choppy Sandhills (CS):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the very coarse (loamy sand) textural subgroup. CS applies to soils that occur on duned landscapes, including D11, D1m, D1h, D2l, D2m and D2h in AGRASID 3.0. Applies to the soil series Ardenode (ARE).

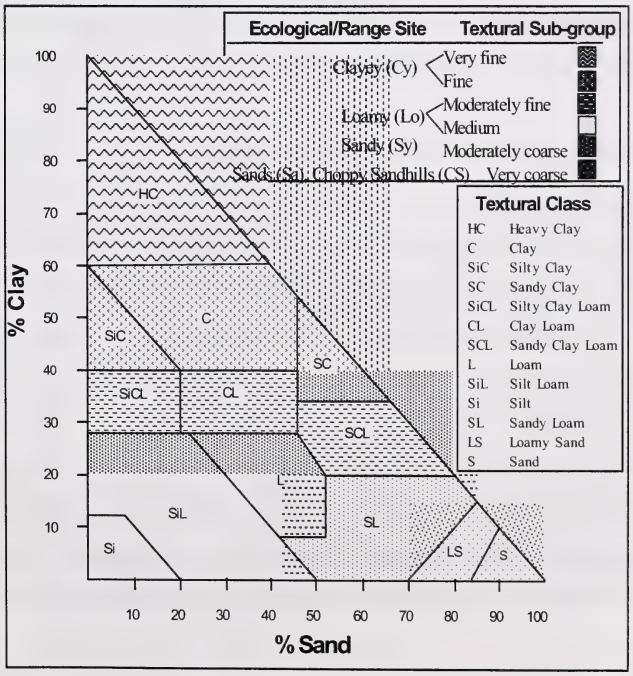
Gravel (Gr):

Applies to any soil with less than 20 cm of a surface mantle of any textural class over very gravelly or very cobbly (>50% gravel or cobbles) material. Applies to the Rinard (RND) and Bow Valley (BOV) soil series.

Shallow to Gravel (SwG):

Applies to any soil with 20 to 50 cm of a surface mantle of any textural class overlying gravelly or very gravelly or cobbly to very cobbly (>20% gravel or cobbles) material. Applies to the Blackfoot (BFT), Rockford (RFD) and Rosebud (RSB) soil series.

Fig. 4. Soil textures and their relationship to ecological/range sites.



Why is plant community important?

Ranchers and range resource managers generally strive to maintain plant communities at or near the climax or potential natural community (PNC) stage because they provide higher levels of ecological functioning. Healthy range plant communities are said to perform important ecological functions and to provide a broader suite of goods and services than lower seral stages. A rich history of grazing research has been undertaken in the Foothills Fescue grassland and continues at Stavely, the Agriculture and Agri-Food Canada research substation, which was established in 1948. The original studies were undertaken to understand carrying capacity. Much of this research considers the character and response of the rough fescue grassland to a spectrum of grazing intensities that have either maintained or transformed the plant community and soils. The highlights of this research are reviewed below. The major functions of intact rough fescue grasslands are summarized in Table 7. These special attributes help us to understand why rough fescue in now Alberta's provincial grass.

Long-Term Stocking Rates Study

One of the principal long-term studies compared the effects of four stocking rates over a 35 year period (Johnston 1962, Johnston et al. 1971, Willms et al. 1985, Dormaar and Willms 1990): **light**, 2.0 acres per Animal Unit Month (ac./AUM); **moderate**, 1.5 ac./AUM; **heavy**, 1.0 ac./AUM; and **very heavy**, 0.5 ac./AUM. The initial impact was to replace the deep-rooted and productive rough fescue with shorter and shallow-rooted species including Parry's oatgrass and Idaho fescue. With very heavy grazing, the plant community was further modified to dominance by Parry oatgrass but included many weedy species such as common dandelion, sedges and pussytoes. Rough fescue was largely eliminated from the stand after five years of heavy grazing and the lowest level of range condition was recorded after 13 years of very heavy stocking (Willms et al. 1985). Forage production declined by 50% from a stable average of 1780 lb./ac. and became far more variable and more dependent on current precipitation (Willms et al. 1985). Stocking at 1.5 ac/AUM was judged as the best of the four rates to sustain the plant community.

Grazing Impacts on Soils and Watershed Function

The soil responses to very heavy stocking followed those of the vegetation, i.e., the character of the soil was modified to that of a drier climatic region (Johnston 1962, Willms et al. 1985). With changes in the vegetation there was a corresponding decline in soil organic matter, loss of soil structure, increased surface sealing and reduced infiltration rates (Johnston 1962, Johnston et al. 1971, Naeth et al. 1990). With reduced levels of surface residue in the form of carryover, increased evaporation and reduced snow catch were likely consequences (Dormaar and Willms 1990). The net effect was less soil water to support plant growth.

Grassland plant cover normally prevents soil erosion, regardless of stocking rates. Naeth et al. (1990) reported the decline in water infiltration rates with heavy stocking rates due to excess removal of plant cover and soil compaction. As grazing intensity increased, water intake and water holding capacity declined. The consequence was more runoff. Once a threshold value of 10 to 15% soil exposure was exceeded, soil erosion processes

increased such that they contributed to loss of more than 5 cm of Ah horizon under the heavy grazing treatment. In a related study, measurable declines in soil quality could be detected on fescue grassland (Dormaar et al. 1989) in as little as five years at high rates of forage utilization (80%).

In very recent studies at Stavely (Chanasyk et al. 2002, Manfumo et al. 2002), runoff rates were higher on heavy to very heavily grazed fescue grassland during larger summer storm events and during spring runoff from snow melt.

Plant Community Weathering Losses

Rough fescue is considered a "hard" grass. A well developed sclerenchymatous layer in the leaves and the characteristic of leaf rolling permit a high curability and hence improves the grass's value for dormant season grazing. Willms et al. (1996) reported that plant community and growing conditions had a strong influence on dry matter losses in the fescue prairie. Weathering, trampling and herbivory (insects and mammals) may limit the amount of forage available for livestock to graze. In a three year study at Stavely, average losses for a rough fescue community 24%. Weathering losses increased dramatically to 43% in the Parry Oatgrass - Kentucky Bluegrass community and to 56% the Kentucky bluegrass - low sedge type. The term "soft grass" is applied to this latter community due to the higher weathering potential. The key management implications are that overgrazing diminishes the value of fescue prairie for winter grazing and weathering losses must be factored in when setting forage utilization levels.

Winter Grazing

The Foothills Fescue prairie is renowned for its adaptation to provide winter forage for livestock and wildlife species like elk. Fescue grasslands can be readily damaged by heavy grazing pressure in summer but are very tolerant of winter grazing (Willms et al 1998). Historically, fescue prairie supported populations of wintering bison. Long term ranching practice and research at Stavely have confirmed winter grazing of rough fescue as an economical and sustainable practice (Willms et al. 1993) although it must be stressed that rough fescue must be present as a significant part of the pasture composition since it will provide most of the winter forage when snow is present. A number of efficiencies are gained with winter use. One common misconception is that winter grazing is advantageous because heavy utilization of forage is possible because plants are dormant. Research shows that other reasons likely explain the adaptation to winter grazing:

- In clipping studies of rough fescue, highest herbage yields were provided by a single harvest during dormancy. Multiple harvests and clipping during the growing season provided lower herbage yields (Willms and Fraser 1992).
- Livestock will tend to graze rough fescue more uniformly during winter given its availability through the snow and its erect and available structure.

The long-term stocking rate studies at Stavely showed that in the moderate grazing treatment, under season-long grazing (the rate that generally maintained range condition), forage utilization averaged only 30 to 40% (Willms, personal communication). In the winter grazing studies (Willms et al, 1993), forage use averaged less than 50%. Though fescue prairie soils have the highest moisture regime of any other plant community in the Grassland Natural Region, litter residue must still be provided. Litter enhances forage production by improving moisture infiltration, reducing soil temperature

and reduced evapo-transpiration. Without adequate litter or mulch, forage yields will likely be reduced by about one third during dry years (Willms 1995). Heavy grazing of winter range will have a "drying out" effect on fescue prairie. Yields will be lower in dry years and more unstable. This drying effect from heavy use of winter range is borne out by much anecdotal evidence from rancher experience. Heavy grazing of rough fescue plants also results in more tillers per plant but shorter leaves (Willms and Fraser 1992). This may make rough fescue forage less available depending on snow conditions.

Table 7. Functions and attributes of healthy rough fescue plant communities.

Functions and Characteristics of Rough Fescue Plant Communities	Why are healthy plant communities important? Impact of excessive disturbance on values and functions.
Forage Productivity	• forage production is highest from the rough fescue-dominated communities in the black soil zone • forage yield potential declines with species shifts to Parry's oatgrass and Kentucky bluegrass - sedge
Forage Quality and Availability	• forage quality in rough fescue may be similar to many other graminoids in the community during spring and summer, but rough fescue cures better and is more available through the snow during dormancy
Production Stability and Risk	• forage yields tend to be very stable in rough fescue-dominated communities given deep rooting • as species shift to lower seral communities, forage yields fluctuate more and are more dependent on current precipitation conditions
Managerial Efficiency and Flexibility	• high curability of rough fescue permits winter grazing, reducing wintering costs and making grazing options more flexible for the producer • lower successional communities are subject to greater forage weathering losses and declines in forage quality and are unsuitable for winter grazing
Ranch Maintenance Costs	• as rough fescue canopy cover declines, other more grazing resistant species increase; at heavy to very heavy rates weed invasion will increase resulting in higher maintenance costs for weed control
Site Stability and Soil Maintenance	• rough fescue communities normally have little exposed soil and are stable; soil loss increases as soil exposure exceeds about 10 to 15% • 5 to 7 cm of topsoil may be lost after 40 years of very heavy grazing pressure
Moisture Retention and Watershed Function	• rough fescue communities produce substantial litter that serves to conserve scarce moisture, enhance moisture infiltration and retention • heavy grazing pressure increases soil compaction and reduces infiltration into the soil; runoff increases accompanied by an increase in soil erosion
Plant Community Structure	• late seral communities feature tall bunchgrass structure • plant community structure declines towards lower seral communities
Wildlife Habitat Values	• rough fescue provides quality winter forage for elk and high cover values for a wide variety of wildlife species
Vulnerability to Grasshopper Impacts and Soil Insect Abundance	• healthy range will resist change caused by grasshoppers; forage supply is more abundant and rough fescue provides poor egg laying sites • abundance and diversity of soil arthropods (mites) was greater in the more productive rough fescue communities
Biodiversity Maintenance	• highest species richness at light to moderate levels of grazing • ungrazed rough fescue has simpler species composition with litter build up and heavy to very heavy grazing leads to species impoverishment • with heavy grazing pressure, invasion by agronomic species leads to serious decline in plant species diversity

4.0 Previous Plant Community Studies
4.1 Native Plant Communities

A seminal monograph on the rough fescue association is titled The Fescue Grassland in Alberta (Moss and Campbell, 1947) and some of the highlights are summarized below. The original fescue grassland association, was considered to occupy any landscapes with Black Chernozemic features and most of the organic accumulation in these soils was attributed to a single species: rough fescue. The zone was considered to be much larger than its current extent due to fire control which accompanied European settlement permitting forest expansion and modification of grassland soils due to forest soil genesis processes.

In most areas of the rough fescue association, the bunchgrass may grow to the exclusion of other species under light grazing impact. In southwestern Alberta, Parry oatgrass may replace rough fescue as grazing pressure increases and may also form an edaphic climax on some sites. Moss and Campbell noted, though rough fescue normally dominates in climax communities, that Parry Oatgrass may be locally dominant on shallow soils of rocky and gravelly slopes and sites that are windblown. They also correlated this phenomena with the area between Waterton and the southern Porcupine Hills. Moss and Campbell felt that rough fescue prairie was the true climax prairie of the foothills region and was not heavily impacted by bison like many areas of the Mixedgrass prairie (Coupland 1961). It could be that the role of dormant season grazing was not understood as the key to the maintenance of rough fescue communities. This is also the most likely regime under which bison also used the prairie (Epp 1992).

Moss and Campbell also described important ecological gradients to other natural regions. In the southwest of Alberta's Foothills Fescue, species associated with the Palouse prairie (Central Washington) to the west and southwest were recognized including Idaho fescue, Columbian needle grass, bluebunch wheatgrass and a number of forbs including sticky geranium and balsam root. Along the eastern and southern extent of the fescue association, a number of needle grass species were recognized as co-dominant.

Coupland described the fescue association of the Cypress Hills as an important outlier of fescue association (Coupland 1961). He further described the communities that adjoin the black soil zone in the mixed prairie where rough fescue is less competitive, where western porcupine grass is a key subdominant and where ground cover from little club moss is much more significant than in the black soil zone.

Looman (1982) and Hills et al. (1995) defined three rough fescue zones in Alberta: 1) the largest of the three in east-central Alberta is dominated by plains rough fescue *(Festuca hallii)*; 2) in the southwest and on the top of the Cypress Hills bench, is dominated by foothills rough fescue (*Festuca campestris*); and 3) extends north of 50 degrees N, in the foothills and mountains of north-central Alberta and is dominated by northern rough fescue (*Festuca altiaca*) .

Rough Fescue - Idaho Fescue is a major community type extending from Montana into southwestern Alberta (Mueggler and Stewart, 1980). In Montana, this type occupies sites more mesic in character than Rough Fescue - Bluebunch Wheatgrass, another Palouse

prairie type of British Columbia and the Northwestern US. Range sites for this type are mostly loamy with a wide variety of slopes but generally less than 30%.

Rough fescue dominated communities have been classified for the Upper Foothills, subalpine and Montane Subregions of southwestern Alberta (Willoughby (1999, 2001) and Willoughby et al. (2003). In these three natural subregions Willoughby describes 35 rough fescue dominated communities. The majority are grassland communities, four are shrub types and five involve forest succession. About two thirds of the communities were either late-seral in character or representative of grazing succession. About 10 of 35 communities have been modified by grazing and other disturbances to include a significant component of non-native species like Kentucky bluegrass. One of the key plant communities relative to this study is the Rough Fescue - Idaho Fescue - Parry Oatgrass community (Willoughby et al., 2003). Like Moss and Campbell (1947), this community is considered a modal community broadly representative of Black Chernozemic soils at 1300 to 1900 m elevation. In the Montane, Willoughby et al. (2003) have consider Idaho Fescue-Parry Oatgrass - Rough Fescue to be an edaphic climax community found generally upslope of the rough fescue type described above.

4.2 Modified Plant Communities

A number of agronomic grasses may invade Foothills Fescue grassland, especially with excessive disturbance from activities like road construction, overgrazing, oil and gas development, logging and recreational activities. For example, Kentucky bluegrass, a native of Europe and northern Asia, has been considered an invasive non-native species in much of North America:

> *Indians referred to it as "white man's foot grass"; they believed that, wherever the white man trod, this grass later grew as enduring markers of his footprints. The invasion and expansion of Kentucky bluegrass were so marked and rapid that early Kentucky pioneers .....wrote about the abundance of grass meadows similar to those of Europe. At present most authorities agree that* ***Kentucky bluegrass****, like* ***timothy*** *and* ***other cultivated grasses****, was introduced into the country from the Old World, where it is native...(USDA 1988)*

Invasion of Alberta grassland communities by agronomic grasses is most apparent in the black soils of the foothills and parkland. Moisture availability will strongly influence the competitiveness of these species as they move into native plant communities. Table 8 shows the frequency of agronomic species in the Foothills Fescue Grassland vs. Foothills Fescue Parkland vegetation based on the plot data that has been evaluated in this report. In the Foothills Fescue, 68% of plots sampled contained Kentucky bluegrass, with 36% containing Timothy and 7% containing awnless brome. In the Foothills Parkland, Kentucky bluegrass had a similar frequency of occurrence in plots, but Timothy and awnless brome were two and three times more frequent in the moister growing environment of the foothills parkland.

Table 8. Percent of plots with Kentucky bluegrass, Timothy or awnless brome grass in two natural subregions.

Natural Subregion n=sample plots	Kentucky bluegrass	Timothy	Awnless Brome
Foothills Fescue n=487	68	36	7
Foothills Parkland n=410	75	73	21

Once invaded by non-native species, the potential for recovery to a native community seems quite limited based on current knowledge. Willoughby (1997) found that some rangeland reference area sites which were protected from grazing before Kentucky bluegrass became established recovered to Rough Fescue-Idaho Fescue-Parry Oatgrass in 20-30 years. In contrast sites that had significant Kentucky bluegrass invasion recovered to a Rough Fescue-Kentucky Bluegrass-dominated community over the same time period instead. Brown (1997) attempted to reduce the cover and competitiveness of awnless brome and Kentucky bluegrass on a project site near Calgary with repeated fire and mowing treatments but was met with poor results. At Stavely, a 6 year regime of annual cropping with glyphosate applied in the first year failed to eliminate agronomic grasses like Kentucky bluegrass from plot sites adjoining native grassland (Willms, personal comm.).

5.0 Classification Methods
5.1 Plant Community Classification Methods

Data for this analysis consisted mostly of range survey and rangeland reference area data collected by Alberta Sustainable Resource Development from 1986 until present. A total of 487 vegetation inventory forms were analyzed. All data records were reviewed for completeness, species seven letter codes were assigned along with a unique identifier number for each transect. The data were then entered into the Prairie Data Base (Rangeland Management Branch, Alberta Sustainable Resource Development). The data base calculates mean values for species composition, total vegetation, moss/lichen and bare soil cover.

The results of vegetation transect queries were extracted from the Prairie Data Base and formatted for analysis in a two dimensional matrix in the *.wk1 format that PC-ORD requires. Ordination and classification studies were carried out on the data sets using PC-ORD (MJM Software, Gleneden Beach, Oregon). The corresponding land data including soils and site information were sorted into a corresponding land data matrix.

In order to establish major plant community types, ordination and classification interpretations were developed by using two statistical procedures (Willoughby 1997):
a) De-trended Correspondence Analysis was applied (Gauch 1982). This procedure compares similarity and dissimilarity among sites. Plotting of the ordination scores in three dimensional "species space" allows viewing of site and species distributions and facilitates grouping of sites by community types.
b) A cluster analysis procedure was employed as an alternate grouping technique to compare and contrast with the results of the DCA procedure. Ward's method of cluster analysis was the most easily interpreted from the six or more procedures that might be chosen.

Plant community type summaries were generated in Quattro 9 by averaging plant species composition, range in composition and percent constancy of occurrence among groups of vegetation inventory plots considered to form a unique plant community type. Environmental data were subsequently sorted into the same plant community groups as described above for further analysis and correlation with plant community groupings. Total vegetation canopy cover, moss/lichen and bare soil estimates were also calculated for the plant community type groupings of vegetation inventory plots. The resulting plant community descriptions are reported in one page summaries similar to those used by Willoughby et al. (2003).

Ecologically sustainable stocking rates (ESSR) values are suggested for each plant community. These values reflect the maximum number of livestock (e.g.Animal Unit Months (AUM)/acre) that can be supported by the plant community given inherent biophysical constraints and the ecological goal of sustainable health and proper functioning of the plant community. When the ESSR is multiplied by the area (e.g. acres) of a plant community polygon the result is termed **ecologically sustainable carrying capacity (ESCC)**, and is expressed as AUMs. At times, the ESCC must be adjusted for management factors (e.g. reduced livestock distribution), management goals (e.g. improve rangeland health, multiple use and values, etc.), drought conditions, and other natural phenomena impacting the site (e.g. forage quality, fire, pests, etc.). This

adjusted/reduced value is the **ecologically sustainable grazing capacity (ESGC)**. The ESGC values are not provided in the plant community guide because the necessary adjustments are determined by the rangeland resource manager.

Suggested ESSR values may be determined from a combination of forage yield clipping studies, long-term rangeland reference area data, estimated production and historical grazing experience. In order to sustain ecological health and function of the plant community, the ESSR was based on historical grazing rates where the information was available, and on forage yield data when historic grazing records were not available. A number of assumptions underlie the development of ESSRs:

- Ecologically sustainable forage utilization levels are set between 25 % to 50% total herbage production for grassland plant community types and the forage requirements of one animal unit (i.e. 455 kg of dry matter per month).
- The remaining biomass production (carry over), is allocated for the maintenance of ecological functions (e.g. nutrient cycling, viable diverse plant communities, hydrological function, and soil protection, etc.) and plant community services (forage production, habitat maintenance, etc.).
- The allocation of biomass production in this manner is well established and supported by the scientific community, and the amount required varies with Natural Subregion (Holechek et al. 1995).

In this study, the historical grazing records and forage productivity data were correlated in establishing ecologically sustainable stocking rate (ESSR) value through the following steps:

- A ranking was made of major reference plant communities by ecological range site, based on productivity data where available from rangeland reference areas.

- Existing ESSR estimates were correlated with the appropriate range sites from Wroe et al. 1988.

- New carrying capacity data were summarized from grazing records on file for selected grazing dispositions that typify a particular plant community.

- A review team of experienced field staff then reviewed the suggested carrying capacity values and modified carrying capacity estimates where appropriate.

- In the absence of grazing records, and especially with minor plant community types that normally have a small area of occurrence on the landscape, forage yield data or forage yield estimates were applied to derive an ESSR.

6.0 Results and Discussion

The analysis evaluated 487 vegetation plots and distinguished 30 plant communities of which 20 were native grassland types, four were modified grasslands and six were shrub types. The reference plant communities, their corresponding successional communities and modified communities are summarized in Table 9. Ecologically Sustainable Stocking Rate values and ranges are provided in Table 10. Each of the 28 plant

communities is summarized on pages 31- 62. A total of 60 unclassified vegetation plots are summarized in Table 21 of Appendix 9.3. Owing to small sample size or unacceptable variability in the ordination Eigen values, the plots were not designated as plant communities in this approximation. As additional data become available, these unclassified plots will be reconsidered in future refinements of this guide.

Reference plant communities and associated successional communities were defined for seven ecological range sites including wetland/subirrigated, four loamy types, gravel/shallow to gravel and thin breaks. The most significant of these are the three loamy types designated as loamy 1, 2 and 3 (Table 9).

- The Loamy 1 plant community (FFA5) Rough Fescue - Parry Oatgrass, represents the moistest of upland loamy sites and is most common in the Willow Creek Upland. Historically, this type was likely extensive in the Delacour Plain, where only small remnant parcels of native grassland remain today. FFA5 is recognized by the presence of Parry oatgrass which may occur with or without Idaho fescue as a co-subdominant.
- Loamy 2 (FFA2) Rough Fescue - Idaho Fescue, tends to occur in more southerly portions of the Willow Creek Upland and south to the US border. This type seems to define a north-south moisture gradient, with Parry oatgrass dropping out of the stand in the southern Porcupine Hills and Oldman river drainage in the Cardston Plain.
- Loamy 3 (FFA1) is a dry loamy range sites and is found along the eastern boundary with the Mixedgrass Natural Subregion and the Milk River Ridge. The presence of Western wheatgrass signals the transition to the drier Mixedgrass prairie that adjoins the Foothills Fescue to the east.
- Loamy 4 is a transition plant community (FFA24) to the Mixedgrass and is the driest of the loamy types.

Gravel/shallow to gravel range sites are common in the Pekisko and Oldman drainages. Limy range sites are commonly found in the Cardston Plain and the Del Bonita Upland. While plant communities closely resemble a number of loamy types, subtle difference in subdominant species are evident and productivity for these sites is considerably lower than on loamy sites.

Successional community types, where defined, are listed for each reference plant community in column three of the Table 9 and are ordered in descending successional ranking. Plant species changes for each plant community are described in the summary pages for each plant community. A significant feature of plant community changes, as disturbance increases, is the increase in non-native species like Kentucky bluegrass.

Table 9. Plant communities listed by ecological range site within the Foothills Fescue grassland.

Ecological Range Site	Range Plant Community (Reference Plant Community)	Successional Community Types	Modified Plant Communities
Beaked Willow/Tufted Hair Grass **(Wetland and Subirrigated)**	FFC2 Beaked Willow/Sedge - Tufted Hair Grass	FFA15 Sedge-Kentucky Bluegrass-Tufted Hairgrass	FFC3 Beaked Willow/Kentucky Bluegrass – Tufted Hairgrass FFC1 Common Wild Rose/Kentucky Bluegrass – Dandelion
Foothills Rough Fescue **(Loamy 1)**	FFA5 Rough Fescue – Parry Oatgrass	FFA6 Parry Oatgrass - Rough Fescue FFA19 Kentucky Bluegrass - Rough Fescue	FFB1 Kentucky Bluegrass – Timothy
Foothills Rough Fescue **(Loamy 2)**	FFA2 Rough Fescue - Idaho Fescue - Sedge	FFA3 Rough Fescue - Fringed Sage FFA4 Sedge - Fringed Sage	FFB2 Kentucky Bluegrass
Foothills Rough Fescue **(Loamy2 Steep Slopes)**	A23 Rough Fescue - Richardson Needle Grass		
Foothills Rough Fescue **(Loamy 3)**	FFA1 Rough Fescue - Idaho Fescue - Western Wheatgrass	FFA14 Northern Wheatgrass – Western Porcupine Grass	
Foothills Rough Fescue **(Loamy 4)**	FFA24 Rough Fescue - Western and Northern Wheatgrass	FFA25 Northern and Western Wheatgrass - Rough Fescue FFA26 Awnless Brome - Northern and Western Wheatgrass	FFB3 Awnless Brome - Alfalfa FFB4 Kentucky Bluegrass- Awnless Brome
Foothills Rough Fescue **(Loamy 4 - Steep Slopes)**	FFA27 Northern and Western Wheatgrass - Green Needle Grass	FFA28 Green Needle Grass - Fringed Sage	
Foothills Rough Fescue **(Limy 1)**	FFA29 Northern and Western Wheatgrass - Rough Fescue		
Foothills Rough Fescue **(Limy 2)**			FFC5 Snowberry/Awnless Brome-Kentucky Bluegrass

Ecological Range Site	Range Plant Community (Reference Plant Community)	Successional Community Types	Modified Plant Communities
Foothills Rough Fescue **(Gravel and Shallow to Gravel)**	FFA9 Rough Fescue – Parry's Oatgrass	FFA10 Parry's Oatgrass – Rough Fescue – Idaho Fescue FFA13 Idaho Fescue – Rough Fescue	
Foothills Rough Fescue **(Thin Breaks 1)**	FFA17 Rough Fescue – Parry's Oatgrass – June Grass	A18 Parry's Oatgrass – Rough Fescue – Western Porcupine Grass FFC4 Creeping Juniper/Parry Oatgrass - Western Porcupine Grass	
Foothills Rough Fescue **(Thin Breaks 2)**	FFC6 Creeping Juniper/Northern and Western Wheatgrass		

Table 10. Range plant communities and ecologically sustainable stocking rates (AUM/ac and acres/AU) by ecological range site within the Foothills Fescue grassland.

Community Number (Range Site)	Community Type (RPC(reference plant community), Successional, *Modified*)	ESSR AUM's/Acre	ESSR Range AUM's/Acre	ESSR acres/AU	ESSR Range acres/AU
FFC2	**Beaked Willow/Sedge - Tufted Hair Grass**	1.3	1.0-1.5	9	8-12
FFA15	Sedge-Kentucky Bluegrass-Tufted Hairgrass	0.9	0.8-1.3	13	9-15
FFC3	*Beaked Willow/Kentucky Bluegrass - Tufted Hairgrass*	0.8	0.5-1.0	15	12-24
FFC1 (WL and Sb)	*Common Wild Rose/Kentucky Bluegrass - Dandelion*	0.5	0.4-0.6	24	20-30
FFA5	**Rough Fescue - Parry's Oat grass**	0.65	0.55 - 0.7	18	17-24
FFA6	Parry's Oatgrass - Rough Fescue	0.5	0.45-0.55	24	23-27
FFA19	Kentucky Bluegrass - Rough fescue	0.45	0.40-0.50	26	24-30
FFB1 (Lo1)	*Kentucky Bluegrass - Timothy*	0.4	0.35-0.45	30	27-34
FFA2	**Rough Fescue - Idaho Fescue - Sedge**	0.55	0.50-0.60	22	20-24
FFA3	Rough Fescue - Fringed Sage	0.4	0.35-0.45	30	27-34
FFA4	Sedge - Fringed Sage	0.3	0.25-0.32	40	37-48
FFB2 (Lo2)	*Kentucky Bluegrass*	0.3	0.25-0.35	40	34-48
FFA23 (Lo2 steep slopes)	**Rough fescue - Richardson Needle grass**	0.4	0.35-0.45	30	27-34
FFA1	**Rough Fescue - Idaho Fescue - Western Wheatgrass**	0.5	0.45-0.55	24	23-27
FFA14 (Lo3)	Northern Wheatgrass - Western Porcupine Grass	0.35	0.30-0.40	34	30-40
FFA24	**Rough fescue - Western and Northern Wheatgrass**	0.4	0.35-0.45	30	27-34
FFA25	Northern and Western Wheatgrass - Rough Fescue	0.35	0.30-0.4	34	30-40
FFA26	Awnless Brome - Northern and Western Wheatgrass	0.32	0.28-0.35	38	34-43
FFB3	*Awnless Brome - Alfalfa*	0.35	0.3-0.4	34	30-40
FFB4 (Lo4)	*Kentucky Bluegrass- Awnless Brome*	0.32	0.28-0.35	38	34-43

FFA27 FFA28 **(Lo4 steep slopes)**	**Northern and Western Wheatgrass - Green Needle Grass** Green Needle Grass - Fringed Sage	0.32 0.25	0.28-0.37 0.20-0.30	38 48	32-43 40-60
FFA29 **(Limy 1)**	**Northern and Western Wheatgrass - Rough Fescue**	0.35	0.25-0.37	34	32-48
FFC5 **(Limy 2)**	*Snowberry/Awnless Brome-Kentucky Bluegrass*	0.25	0.2-0.30	48	40-60
FFA9 FFA10 FFA13 **(Gr/SwG)**	**Rough fescue - Parry's Oatgrass** Parry's Oatgrass - Rough Fescue - Idaho Fescue Idaho fescue - Rough fescue	0.4 0.35 0.3	0.35-0.45 0.30-0.45 0.27-0.32	30 34 40	34-27 27-40 37-44
FFA17 FFA18 FFC4 **(TB1)**	**Rough fescue - Parry's oatgrass - June grass** Parry's Oatgrass- Rough fescue- Western Porcupine grass Creeping Juniper/Parry oatgrass - Western Porcupine grass	0.35 0.3 0.3	0.30-0.45 0.25-0.35 0.25-0.35	34 40 40	27-40 34-48 34-48
FFC6 **(TB2)**	**Creeping Juniper/Northern and Western Wheatgrass**	0.28	0.25-0.32	43	43-48

Foothills Rough Fescue - Idaho Fescue - Western Wheat Grass - FFA1

(Festuca campestris - Festuca idahoensis - Agropyron smithii) Herbaceous

n=9 This is the reference plant community for black loamy soils in the Foothills Fescue prairie on the Milk River Ridge and in the eastern portions of the Foothills Fescue prairie adjoining the Mixedgrass prairie. Soils are medium textured, well drained with Orthic Black Chernozems and surface Ah horizons less than 20 cm in thickness (often 10 - 15 cm). This community type occurs on very similar soils to FFA2, but in the more southerly and southeasterly portions of the subregion in areas of higher summer temperature extremes. With heavy grazing pressure, rough fescue is replaced by Idaho fescue and numerous forb species especially by pasture sage, lupine and golden bean. This plant community will have slightly more soil exposure as well as moss/lichen cover than in FFA2 or FFA5. Winter Chinook winds expose this grassland type and it is commonly used for winter grazing, a practice which serves to maintain a high abundance of rough fescue. In this drier variant of the foothills rough fescue community, litter management is important to maintain moisture retention on the site. Productivity data reported here is from monitoring of unburned grassland adjoining the Granum fire area for the years 1998 to 2000.

Soil Exposure: 7 % (0-28)**Moss/Lichen Cover:** 9 % (0 - 66) **Total Vegetation:** 87% (66 - 97%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
UNDIFFERENTIATED ROSE (*Rosa*)	1	0-5	67
BUCKBRUSH *(Symphoricarpos occidentalis)*	3	0-8	89
FORBS			
PASTURE SAGEWORT *(Artemisia frigida)*	1	0-5	78
SILVERY PERENNIAL LUPINE *(Lupinus argenteus)*	1	0-2	78
GOLDEN BEAN *(Thermopsis rhombifolia)*	1	0-4	56
UNDIFFERENTIATED ASTER *(Aster)*	1	0-2	56
GRASSES			
FOOTHILLS ROUGH FESCUE *(Festuca campestris)*	61	36-85	100
IDAHO FESCUE *(Festuca idahoensis)*	7	1-13	100
WESTERN WHEAT GRASS *(Agropyron smithii)*	6	1-11	100
UNDIFFERENTIATED SEDGE *(Carex)*	5	3-11	100
JUNE GRASS *(Koeleria macrantha)*	1	0-4	44
GREEN NEEDLE GRASS *(Stipa viridula)*	1	0-3	44

ENVIRONMENTAL VARIABLES

RANGE SITE
LOAMY 3

SOILS
ORTHIC BLACK (HILLMER, DEL BONITA)

ELEVATION (M):
1250 TO 1300

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
VERY GENTLE; GENTLE

ASPECT:
N/A

FORAGE PRODUCTION (LB/AC)

GRASS	1194 (859-1420)
FORB	297 (97-403)
SHRUB	NOT AVAILABLE
LITTER	1334 (799-1870)
TOTAL	1491 (1156 - 1823)

Ecologically Sustainable Stocking Rate
0.50 Aum/ac

Foothills Rough Fescue - Idaho Fescue - Sedge - FFA2

(Festuca campestris - Festuca idahoensis - Carex spp.) Herbaceous

n=28 This is the reference plant community for black loamy sites in the Foothills Fescue grassland. Soils are medium textured, well drained Orthic Black Chernozems and surface Ah horizons of 10 - 15 cm in thickness (normally 10 - 15 cm). This community type occurs on very similar soils to FFA5, but is more common in the southern portion of the subregion, on black soils adjoining the Mixedgrass prairie and areas of higher summer temperature extremes like the Oldman River valley. With heavy grazing pressure, rough fescue is replaced by Idaho fescue and numerous forb species. This plant community normally has close to complete ground cover with little exposed soil. Winter Chinook winds expose this grassland type and it is commonly used for winter grazing which serves to maintain a high abundance of rough fescue. Forage production data presented here is from the Waldron Ranch rangeland reference area.
Soil Exposure: 9 % (1-28)**Moss/Lichen Cover:** 7 % (1 - 35) **Total Vegetation:** 77% (45 - 96%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
CREEPING JUNIPER *(Juniperus horizontalis)*	T	0-7	8
FORBS			
THREE-FLOWERED AVENS *(Geum triflorum)*	2	0-15	39
GRASSES			
FOOTHILLS ROUGH FESCUE *(Festuca campestris)*	36	13-59	100
IDAHO FESCUE *(Festuca idahoensis)*	12	2-35	100
UNDIFFERENTIATED SEDGE *(Carex)*	9	0-16	93
NORTHERN WHEAT GRASS *(Agropyron dasystachyum)*	5	0-14	96
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	6	0-25	75
CALIFORNIA OAT GRASS *(Danthonia californica)*	3	0-19	46
PARRY OAT GRASS *(Danthonia parryi)*	4	0-16	43
JUNE GRASS *(Koeleria macrantha)*	3	0-9	93
RICHARDSTON NEEDLE GRASS *(Stipa richardsonii)*	1	0-22	14

ENVIRONMENTAL VARIABLES

RANGE SITE
LOAMY 2

SOILS
ORTHIC BLACK (BEAZER, DEL BONITA, BULLHORN AND STANDOFF)

ELEVATION (M):
M

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
MODERATE, STRONG, VERY STRONG, GENTLE

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	1340 (351 - 1909)
FORB	221 (106 - 362)
SHRUB	NOT AVAILABLE
LITTER	1126 (721 - 1982)
TOTAL	1561 (713 - 2015)

Ecologically Sustainable Stocking Rate
0.55 Aum/ac

Foothills Rough Fescue - Pasture Sagewort - Idaho Fescue - FFA3

(Festuca campestris - Artemisia frigida - Festuca idahoensis) Herbaceous

n=5 This plant community is a late to mid seral grazing modified stage of the Rough Fescue - Idaho Fescue - Sedge community type within the Foothills Fescue grassland. Reduced rough fescue composition andincreased cover of western porcupine grass, June grass, sedges, pasture sage or three-flowered avens are a result of moderate to heavy grazing. This plant community is fairly responsive to rest and rotational grazing. Range recovery back to rough fescue domination may occur within a five to ten year period with rotational grazing and proper stocking rates. Soil exposure may be substantially increased (16%) and total vegetation canopy is reduced.

Soil Exposure: 16 % (1-31)**Moss/Lichen Cover:**19 % (12 - 34) **Total Vegetation:** 55% (43 - 71%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
CREEPING JUNIPER (*Juniperus horizontalis*)	2	0-9	20
FORBS			
PASTURE SAGEWORT (*Artemisia frigida*)	14	10-17	100
THREE-FLOWERED AVENS (*Geum triflorum*)	1	0-4	40
GRASSES			
NORTHERN WHEATGRASS (*Agropyron dasystachyum*)	9	3-17	100
BLUEBUNCH WHEATGRASS (*Agropyron spicatum*)	2	0-9	20
UNDIFFERENTIATED SEDGE (*Carex*)	8	4-12	100
FOOTHILLS ROUGH FESCUE (*Festuca campestris*)	16	10-31	100
IDAHO FESCUE (*Festuca idahoensis*)	13	7-20	100
JUNE GRASS (*Koeleria macrantha*)	8	2-14	100
ALKALI BLUEGRASS (*Poa juncifolia*)	2	0-8	60
WESTERN PORCUPINE GRASS (*Stipa curtiseta*)	11	3-20	100

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY 2

SOILS:
ORTHIC BLACK (BEAZER, STANDOFF)

ELEVATION (M):
M

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
MODERATE

ASPECT:
N/A

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.40 Aum/ac

Sedge - Pasture Sagewort - Kentucky Bluegrass - FFA4

(Carex spp. - Artemisia frigida - Poa pratensis) Herbaceous

n=6 This is a highly disturbed early seral stage of the Rough fescue- Idaho Fescue-Sedge community type (FFA2). Typical increaser species include pasture sage, low sedges, June grass, early bluegrass and numerous forb species. Abundance of Kentucky bluegrass and dandelion are substantially increased as well. Soil exposure may reach very serious levels (about 35%), a level at which significant surface soil erosion may be evident. Total vegetation canopy is reduced which limits hydrologic functions such as infiltration and moisture retention.

Soil Exposure: 34 % (12-48) **Moss/Lichen Cover:** 14 % (1 - 39) **Total Vegetation:** 42% (18 - 67%)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
BUCKBRUSH (*Symphoricarpos occidentalis*)	1	0-7	17
FORBS			
PASTURE SAGEWORT *(Artemisia frigida)*	13	2-24	100
COMMON DANDELION *(Taraxacum officinale)*	2	0-6	50
GRASSES			
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	10	3-13	100
UNDIFFERENTIATED SEDGE *(Carex)*	18	11-26	100
FOOTHILLS ROUGH FESCUE *(Festuca campestris)*	6	0-10	83
IDAHO FESCUE *(Festuca idahoensis)*	5	0-11	83
JUNE GRASS *(Koeleria macrantha)*	9	3-19	100
EARLY BLUEGRASS *(Poa cusickii)*	4	0-12	83
ALKALI BLUEGRASS *(Poa juncifolia)*	2	0-6	50
KENTUCKY BLUEGRASS *(Poa pratensis)*	11	0-27	83
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	4	0-9	83

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY 2

SOILS:
ORTHIC BLACK (BEAZER, STANDOFF)

ELEVATION (M):
M

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
MODERATE

ASPECT:
SOUTHERLY, WESTERLY

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.30 Aum/ac

Foothills Rough Fescue - Parry Oat Grass FFA5

(Festuca campestris - Danthonia parryi) Herbaceous

n=19 This is a reference plant community for Black Chernozems in the Foothills Fescue Natural Subregion. Soils have mostly loam and silt loam textures, are well drained and have surface Ah horizons generally greater than 15 cm in thickness. In the subregion, this community occurs on a wide range of site positions from well drained valley bottoms to midslopes and strong slopes. This community occurs on similar soils to FFA2 but is more common on the moister ranges of these soils, in the more northerly portions of Soil Correlation Area 5 and in grasslands adjoining the foothills parkland subregion. With heavy grazing pressure, rough fescue is replaced by Parry Oatgrass and numerous forb species. Given the good soil moisture conditions associated with this site and plant community, there is considerable potential for Kentucky bluegrass to become abundant. Shrubby cinquefoil is present but generally at lower canopy cover values than found on shallow-to-gravel and gravel sites. This plant community normally produces complete ground cover with about 1% soil exposure. This is the one of the most productive grassland plant communities in the foothills environment and is highly prized for winter grazing, a grazing practice which serves to maintain the abundance of rough fescue. Forage production data is from the Stavely Rangeland Reference area.

Soil Exposure: 1% (0-11) **Moss/Lichen Cover:** 1 % (0 - 4) **Total Vegetation:** 96% (83 - 98%)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Shrubby Cinquefoil *(Potentilla fruticosa)*	3	0-11	74
Prairie Rose *(Rosa arkansana)*	2	0-6	74
Forbs			
Silky Perennial Lupine *(Lupinus sericeus)*	3	0-7	84
Golden Bean *(Thermopsis rhombifolia)*	3	0-9	95
Grasses			
Foothills Rough Fescue *(Festuca campestris)*	35	19-46	100
Parry OatGrass *(Danthonia parryi)*	18	10-25	100
Kentucky Bluegrass *(Poa pratensis)*	4	0-13	95
Awned WheatGrass *(Agropyron subsecundum)*	4	0-11	89
Bluebunch Fescue *(Festuca idahoensis)*	3	0-10	95
Undifferentiated Sedge *(Carex)*	2	0-5	95
Northern Awnless Brome *(Bromus inermis* ssp *pumpellianus)*	2	0-6	84
June Grass *(Koeleria macrantha)*	2	0-9	68

Environmental Variables

Range Site:
Loamy 1

Soils:
Orthic Black (Beazer, Del Bonita, Standoff)

Elevation (m):

Soil Drainage:
Well drained

Slope :
Strong, Moderate

Aspect:
N/A

Forage Production (lb/ac)

Grass	1920 (1436 - 2642)
Forb	353 (174 - 614)
Shrub	Not Available
Litter	2400 (1800 - 4200)
Total	2273 (2050 - 2816)

Ecologically Sustainable Stocking Rate
0.65 Aum/ac

Parry Oat Grass - Foothills Rough Fescue - Kentucky Bluegrass FFA6

(Danthonia parryi - Festuca campestris - Poa pratensis) Herbaceous

n=47 This is a late seral plant community on loamy ranges sites with Black Chernozems in the Foothills Fescue grassland. This community type summary is particularly representative of lightly to moderately grazed fescue grasslands on moderate to strong slopes. The prominence of Parry oatgrass is normally thought to be a function of grazing history, but like the Parry Oatgrass-Rough Fescue-Western Porcupine Grass community type, this can be both a reference plant community and a grazing influenced successional community, especially on strong slopes in the Foothills Fescue grassland. Moss and Campbell (1947) and Willoughby et al. (2003) suggest that Parry Oatgrass may be dominant due to grazing pressure and may increase in abundance on steep, exposed and windswept slopes, making evaluation of ecological status difficult. The presence of Kentucky bluegrass at 5% cover is of concern to resource managers as further increases in Kentucky bluegrass will diminish the value of the plant community for grazing and wildlife. Despite minor changes in the plant community, mean soil exposure and moss/lichen cover are low at 2 and 3 % respectively.

Soil Exposure: 2 % (0-16)**Moss/Lichen Cover:** 3 % (0-37) **Total Vegetation:** 93% (50-98)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Shrubby Cinquefoil *(Potentilla fruticosa)*	1	0-8	47
Prairie Rose *(Rosa arkansana)*	1	0-10	72
Forbs			
Silky Perennial Lupine *(Lupinus sericeus)*	2	0-6	62
Golden Bean *(Thermopsis rhombifolia)*	3	0-11	83
Grasses			
Parry Oat Grass *(Danthonia parryi)*	32	8-75	100
Foothills Rough Fescue *(Festuca campestris)*	19	1-34	100
Kentucky Bluegrass *(Poa pratensis)*	5	0-21	72
Western Porcupine Grass *(Stipa curtiseta)*	4	0-19	68
June Grass *(Koeleria macrantha)*	1	0-3	67
Awned Wheat Grass *(Agropyron subsecundum)*	3	0-16	81
Undifferentiated Sedge *(Carex)*	2	0-20	81
Idaho Fescue *(Festuca idahoensis)*	2	0-12	85

Environmental Variables

Range Site:
- Loamy 1
- Thin breaks

Soils:
- Orthic Black Chernozem (beazer, ockey)

Elevation:

Soil Drainage:
- Well drained
- Rapidly drained

Slope :
- Strong
- Moderate

Aspect:
- Southerly
- Westerly

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available
Total	Not Available

Suggested Carrying Capacity
0.50 AUM/ac

Foothills Rough Fescue - Parry Oat Grass - Kentucky Bluegrass FFA9

(Festuca campestris - Danthonia parryi - Poa pratensis) Herbaceous

n=15 This is the reference plant community for gravel and shallow-to-gravel range sites within the Foothills Fescue and Foothills Parkland Natural Subregions. Soils are Orthic Black and Rego Black Chernozems developed on a course outwash gravels. The shallow surface horizons are loam to silt loam in texture. These soils are more droughty in character compared to loamy sites, productivity is lower and less stable. With heavy grazing pressure, rough fescue will be replaced by Parry oatgrass and bluebunch fescue. Even with poorer soil growing conditions, this plant community will normally have only about 4% soil exposure. Productivity data presented here is from the Maycroft Rangeland Reference area (new Rangeland Reference on gravel range site was constructed in 2002 at Rocky Flats).

Soil Exposure: 4 % (0-28)**Moss/Lichen Cover:** 3 % (0-14) **Total Vegetation:** 92% (66-98)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Shrubby Cinquefoil *(Potentilla fruticosa)*	1	0-3	40
Forbs			
Silky Perennial Lupine *(Lupinus sericeus)*	1	0-3	47
Three-flowered Avens *(Geum triflorum)*	4	0-12	87
Northern Bedstraw *(Galium boreale)*	2	0-9	87
Grasses			
Foothills Rough Fescue *(Festuca campestris)*	35	19-65	100
Parry Oat Grass *(Danthonia parryi)*	11	0-32	73
Kentucky Bluegrass *(Poa pratensis)*	7	0-24	60
Idaho Fescue *(Festuca idahoensis)*	6	0-17	93
Undifferentiated Sedge *(Carex)*	5	2-10	100
Northern Wheat Grass *(Agropyron dasystachyum)*	3	0-10	73
Awned Wheat Grass *(Agropyron subsecundum)*	2	0-8	67
Junegrass *(Koeleria macrantha)*	1	0-5	67

Environmental Variables

Range Site:
- Gravel and Shallow to Gravel

Soils:
- Orthic Black Chernozem (Blackfoot, Rockford, Rinard)

Elevation:

Soil Drainage:
- Rapidly drained

Slope :
- Nearly level
- Very gentle
- Moderate

Aspect:
- Southerly
- Northerly

Forage Production (lb/ac)

Grass	1078 (272 - 2262)
Forb	296 (134 - 678)
Shrub	Not Available
Litter	726 (478 - 1139)
Total	1374

Ecologically Sustainable Stocking Rate
0.40 AUM/ac

Parry Oat Grass - Foothills Rough Fescue - Idaho Fescue FFA10

(Danthonia parryi - Festuca campestris - Festuca idahoensis) Herbaceous

n=12 This is a late seral plant community on gravel and shallow-to-gravel range sites in the Foothills Fescue and Foothills Parkland Natural Subregions. Most of the gravel and shallow to gravel parent materials occur along the gradient between the two natural subregions so it is difficult to distinguish communities for each subregion. Soils are Orthic Black and Rego Black Chernozems developed developed on coarse outwash gravels. The outwash shallow surface horizons are loam to silt loam in texture. The increased abundance of Parry Oatgrass and Idaho fescue are normally associated with grazing history but may be a function of site as well. Gravelly soils normally have a higher canopy cover and constancy of shrubby cinquefoil, a shrub that commonly increases with grazing pressure. Compared to loamy soils, gravel and shallow to gravel sites are more droughty, forage yields are lower and less stable. This community type is somewhat more resistant to invasion by Timothy and Kentucky bluegrass than loamy sites. Soil exposure will normally be less than 5% on this type.

Soil Exposure: 1 % (0-3) **Moss/Lichen Cover:** 8 % (0-26) **Total Vegetation:** 92% (83-98)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SHRUBBY CINQUEFOIL *(Potentilla fruticosa)*	2	0-10	50
FORBS			
SILKY PERENNIAL LUPINE *(Lupinus sericeus)*	1	0-4	50
THREE-FLOWERED AVENS *(Geum triflorum)*	3	0-13	58
NORTHERN BEDSTRAW *(Galium boreale)*	2	0-6	92
GRASSES			
PARRY OAT GRASS *(Danthonia parryi)*	32	19-43	100
FOOTHILLS ROUGH FESCUE *(Festuca campestris)*	11	2-24	100
BLUEBUNCH FESCUE *(Festuca idahoensis)*	8	4-14	100
UNDIFFERENTIATED SEDGE *(Carex)*	6	2-11	100
KENTUCKY BLUEGRASS *(Poa pratensis)*	4	0-13	58
AWNED WHEAT GRASS *(Agropyron subsecundum)*	4	1-10	100
JUNE GRASS *(Koeleria macrantha)*	3	0-10	83
TIMOTHY *(Phleum pratense)*	2	0-13	42

ENVIRONMENTAL VARIABLES

RANGE SITE:
- GRAVEL AND SHALLOW TO GRAVEL

SOILS:
- ORTHIC BLACK CHERNOZEM (BLACKFOOT, ROCKFORT, RINARD)
- REGO BLACK CHERNOZEM

ELEVATION:

SOIL DRAINAGE:
- WELL DRAINED
- RAPIDLY DRAINED
- VERY RAPIDLY DRAINED

SLOPE :
- NEARLY LEVEL
- VERY GENTLE

ASPECT:
- SOUTHERLY
- NORTHERLY

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.35 AUM/ac

Idaho Fescue - Foothills Rough Fescue - June Grass FFA13

(Festuca idahoensis - Festuca campestris - Koeleria macrantha) Herbaceous

n=9 This is a late seral plant community in the Foothills Fescue grassland on gravel range sites associated with the Rinard soil series. The reference plant community for this range site is likely dominated by rough fescue but the area of the gravel range site is very small in the Foothills Fescue Subregion. Moderate to heavy grazing pressure will increase the abundance of Idaho fescue along with other grazing resistant grasses like June grass, sedges and wheatgrass species. Due to the aridity of the site, this range site is likely more resistant to invasion from Kentucky bluegrass and Timothy than most loamy range sites. Range recovery is expected to be very slow, since gravel-based soils are shallow and drought prone. Note that the exposed soil and moss/lichen cover is much higher and total vegetation cover much lower than for rough fescue plant communities that have developed on loamy range sites.

Soil Exposure: 11 % (0-19) **Moss/Lichen Cover:** 21% (0-45) **Total Vegetation:** 77% (55-91)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Prairie Rose *(Rosa arkansana)*	1	0-3	44
Forbs			
Pasture Sagewort *(Artemisia frigida)*	2	0-8	89
Common Dandelion *(Taraxacum officinale)*	2	0-9	56
Grasses			
Idaho Fescue *(Festuca idahoensis)*	25	21-32	100
Foothills Rough Fescue *(Festuca campestris)*	13	5-22	100
June Grass *(Koeleria macrantha)*	10	2-20	100
Undifferentiated Sedge *(Carex)*	5	0-11	100
Western Porcupine Grass *(Stipa curtiseta)*	5	0-14	100
Parry Oat Grass *(Danthonia parryi)*	5	0-13	89
Northern Wheat Grass *(Agropyron dasystachyum)*	4	1-11	100
Bluebunch Wheat Grass *(Agropyron spicatum)*	2	0-5	56
Plains Reed Grass *(Calamagrostis montanensis)*	2	0-6	89

Environmental Variables

Range Site:
Gravel

Soils:
Orthic Black Chernozem (Rinard)

Elevation:
1300 to 1350 meters

Soil Drainage:
Well drained
Rapidly drained

Slope :
Level

Aspect:

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available
Total	Not Available

Ecologically Sustainable Stocking Rate
0.30 AUM/ac

Northern Wheat Grass - Western Porcupine Grass - Junegrass FFA14

(Agropyron dasystachyum - Stipa curtiseta - Koeleria macrantha) Herbaceous

n=5 This is a late to mid-seral plant community associated with shallow to gravel and dry loamy range sites on the eastern fringes of the Foothills Fescue grassland near the boundary with the Mixedgrass prairie. This plant community is associated with shallow to gravel soils adjacent to Willow Creek and the Oldman River. Rough fescue may be present but is not dominant given the increased aridity of the site and the transition to Dark Brown Chernozemic soils. A number of Mixedgrass prairie species are prominent in the stand like needle-and-thread grass. The plant community is very similar to the Northern Wheatgrass - Idaho Fescue type found on the eastern slopes of the Milk River Ridge, which is a transitional community between the Foothills Fescue and Dry Mixedgrass natural subregions.

Soil Exposure: 5 % (1-11) **Moss/Lichen Cover:** 9% (0-30) **Total Vegetation:** 86% (80-95)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
BUCKBRUSH *(Symphoricarpos occidentalis)*	2	0-5	40
PRAIRIE ROSE *(Rosa arkansana)*	1	0-4	40
FORBS			
PASTURE SAGEWORT *(Artemisia frigida)*	4	0-10	80
GOLDEN BEAN *(Thermopsis rhombifolia)*	2	0-8	40
GRASSES			
NORTHERN WHEAT GRASS *(Agropyron dasystachyum)*	19	10-33	100
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	13	0-24	80
JUNE GRASS *(Koeleria macrantha)*	7	1-18	100
IDAHO FESCUE *(Festuca idahoensis)*	6	0-24	80
KENTUCKY BLUEGRASS *(Poa pratensis)*	5	0-9	60
UNDIFFERENTIATED SEDGE *(Carex)*	5	0-12	80
FOOTHILLS ROUGH FESCUE *(Festuca campestis)*	5	0-14	40
NEEDLE-AND-THREAD *(Stipa comata)*	4	0-13	60

ENVIRONMENTAL VARIABLES

RANGE SITE:
- LOAMY 3
- SHALLOW TO GRAVEL

SOILS:
- ORTHIC REGOSOL
- ORTHIC DARK BROWN CHERNOZEM
- ORTHIC BLACK CHERNOZEM

ELEVATION:

SOIL DRAINAGE:
- WELL DRAINED
- RAPIDLY DRAINED

SLOPE :
- GENTLE
- MODERATE

ASPECT:
- VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.35 AUM/ac

Undifferentiated Sedge - Kentucky Bluegrass - Tufted Hair Grass

FFA15

(Carex spp. - Poa pratensis - Deschampsia cespitosa) Herbaceous

n=3 This is a mid seral to late seral plant community on sub-irrigated range sites within the Foothills Fescue grassland. This is a drier sedge type than either the beaked sedge or awned sedge types described by Thompson and Hansen (2002) as well as the sedge types reported by Willoughby et.al. (2003) in the Montane natural subregion. It occurs on the nearly level zone between the riparian zone and upland loamy sites, where shallow groundwater and overflow from the adjoining steep slopes provide a sub-irrigation effect. The sites are highly productive but prone to invasion by Kentucky bluegrass and a number of disturbance induced forbs and weeds like Canada thistle and common dandelion which result from increased grazing pressure and other forms of disturbance.

Soil Exposure: 0 % (0-0) **Moss/Lichen Cover:** 0 % (0-0) **Total Vegetation:** 98 % (98-98)

Plant Composition

	Canopy Cover(%)		
	Mean	Range	Const
Shrubs			
Basket Willow *(Salix petiolaris)*	2	0-7	33
Forbs			
Canada Thistle *(Cirsium arvense)*	3	0-7	67
Common Dandelion *(Taraxacum officinale)*	2	1-3	100
Silverweed *(Potentilla anserina)*	2	0-6	67
Grasses			
Sedge *(Carex spp.)*	27	25-30	100
Kentucky Blue Grass *(Poa pratensis)*	13	9-18	100
northern Reed Grass *(Calamagrostis inexpansa)*	10	0-16	67
Tufted Hair Grass *(Deschampsia cespitosa)*	8	7-9	100
Wire Rush *(Juncus balticus)*	4	1-8	100
Timothy *(Phleum pratense)*	3	1-7	100
Narrow Reed Grass *(Calamagrostis stricta)*	3	0-9	33
Mat Muhly *(Muhlenbergia richardsonis)*	2	0-4	67

Environmental Variables

Range Site
- Sub Irrigated

Soils
- Orthic Humic Gleysol
- Cumulic Regosol

Elevation (m):

Soil Drainage:
- Well Drained
- Imperfectly Drained
- Poorly Drained

Slope :
- Nearly Level
- Level

Aspect:
- Easterly

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available
Total	Not Available

Ecologically Sustainable Stocking Rate
0.9 AUM/ac

Foothills Rough Fescue - Parry Oat Grass - June Grass FFA17

(Festuca campestris - Danthonia parryi - Koeleria macrantha) Herbaceous

n=6 This is the reference plant community for thin break sites associated with loamy soils on strong to very strong slopes and mainly south and west aspects. Rough fescue is far less dominant, Parry Oatgrass, June grass, Idaho fescue and western porcupine grass indicate the drier and more exposed character of the site type. Heavy grazing pressure will increase the abundance of the subdominant grazing-resistant grasses and forbs. These sites are particularly vulnerable to hoof shearing from both livestock and wildlife species like elk. Expected soil exposure on healthy sites is close to 5%.

Soil Exposure: 4 % (1-11) **Moss/Lichen Cover:** 10 % (0-37) **Total Vegetation:** 84 % (50-98)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Prairie Rose *(Rosa arkansana)*	1	0-4	67
Forbs			
Golden Bean *(Thermopsis rhombifolia)*	5	1-8	100
Silky Perenial Lupine *(Lupinus sericeus)*	3	0-6	83
Northern Bedstraw *(Galium boreale)*	3	2-4	100
Grasses			
Foothills Rough Fescue *(Festuca campestris)*	25	19-34	100
Parry Oat Grass *(Danthonia parryi)*	22	10-31	100
June Grass *(Koeleria macrantha)*	7	2-16	100
Idaho Fescue *(Festuca idahoensis)*	4	1-11	100
Western Pocupine Grass *(Stipa curtiseta)*	3	0-16	50
Awned Wheat Grass *(Agropyron subsecundum)*	3	0-7	83
Sedge *(Carex spp.)*	3	2-5	100
Kentucky Blue Grass *(Poa pratensis)*	2	0-11	67

Environmental Variables

Range Site:
- thin breaks

Soils:
- Orthic Black (Ockey, owendale)
- Orthic Eutric Brunisol (North Fork)
- orthic regosol (mokowan)

Elevation (m):

Soil Drainage:
- rapidly drianed
- Well Drained

Slope :
- strong

Aspect:
- southerly
- westerly

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available
Total	Not Available

Ecologically Sustainable Stocking Rate
.35 AUM/ac

Parry Oatgrass - Foothills Rough Fescue - Western Porcupine Grass FFA18

(Danthonia parryi - Festuca campestris - Stipa curtiseta) Herbaceous

n=7 This can be both a reference plant community and a grazing influenced successional community on thin break sites with strong and very strong slopes in the Foothills Fescue grassland. Moss and Campbell (1947) and Willoughby et al. (2001) suggest that Parry oatgrass may be dominant due to grazing pressure and may increase in abuncance on steep, exposed and windswept slopes, making evaluation of ecological status difficult. Like FFA17, expected soil exposure is about 5%, the site type is vulnerable to hoof shearing from livestock and ungulates.

Soil Exposure: 5 % (1-14) **Moss/Lichen Cover:** 7 % (1-19) **Total Vegetation:** 91 % (81-98)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
SHRUBBY CINQUEFOIL *(Potentilla fruticosa)*	1	0-5	43
CREEPING JUNIPER *(Juniperus horizontalis)*	4	0-19	43
FORBS			
GOLDEN BEAN *(Thermopsis rhombifolia)*	2	0-4	86
SILKY PERENNIAL LUPINE *(Lupinus sericeus)*	1	0-2	71
GRASSES			
PARRY OAT GRASS *(Danthonia parryi)*	51	38-75	100
FOOTHILLS ROUGH FESCUE *(Festuca campestris)*	11	0-32	86
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	5	0-19	86
SEDGE *(Carex spp.)*	5	0-14	86
JUNE GRASS *(Koeleria macrantha)*	3	0-9	71
IDAHO FESCUE *(Festuca idahoensis)*	2	0-6	86
NORTHERN WHEAT GRASS *(Agropyron dasystachyum)*	1	0-8	57
AWNED WHEAT GRASS *(Agropyron subsecundum)*	1	0-3	57

ENVIRONMENTAL VARIABLES

RANGE SITE:
- THIN BREAK

SOILS:
- ORTHIC BLACK (OCKEY, OWENDALE)
- ORTHIC EUTRIC BRUNISOL (NORTH FORK)
- ORTHIC REGOSOL (MOKOWAN)

ELEVATION (M):

SOIL DRAINAGE:
- WELL DRAINED
- RAPIDLY DRAINED

SLOPE :
- STRONG
- VERY STRONG

ASPECT:
- WESTERLY
- SOUTHERLY

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Suggested Carry Capacity
0.30 AUM/ac

Kentucky Bluegrass - Foothills Rough Fescue - FFA19

(Poa pratensis - Festuca campestris) Shrub Herbaceous

n= 7 This is a mid-seral plant community on loamy ranges sites with Black Chernozems in the Foothills Fescue grassland. This community type is representative of moderately to heavily grazed fescue grasslands on a broad range of slopes from gentle to strong. The dominance of Kentucky bluegrass at 23% marks the movement of the plant community towards modified status. Increased cover of Kentucky bluegrass is of concern to resource managers as the value of the plant community for wildlife and domestic livestock grazing are diminished along with drought hardiness. Stocking at .5 to .65 will serve to maintain the existing community.

Soil Exposure: 0% (0-2) **Moss/Lichen Cover:** 0% (0- 1) **Total Vegetation:** 98%(96 - 100)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
PRAIRIE ROSE *(Rosa arkansana)*	2	0-6	71
SHRUBBY CINQUEFOIL *(Potentilla fruticosa)*	1	0-3	57
FORBS			
GOLDEN BEAN *(Thermopsis rhombifolia)*	3	0-9	86
WILD VETCH *(Vicia americana)*	1	0-4	71
NORTHERN BEDSTRAW *(Galium boreale)*	1	0-3	57
GRASSES			
KENTUCKY BLUEGRASS *(Poa pratensis)*	27	22-32	100
FOOTHILLS ROUGH FESCUE *(Festuca campestris)*	19	3-33	100
PARRY OAT GRASS *(Danthonia parryi)*	14	8-25	100
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	3	0-10	71
NORTHERN WHEATGRASS *(Agropyron dasyystachyum)*	2	0-7	71
AWNED WHEATGRASS *(Agropyron subsecundum)*	2	0-5	71
UNDIFFERENTIATED SEDGE *(Carex)*	1	0-3	57

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY 1

SOILS:
ORTHIC BLACK CHERNOZEM

ELEVATION:
M

SOIL DRAINAGE:
WELL DRAINED
MODERATELY WELL DRAINED

SLOPE :
VERY GENTLE, MODERATE, GENTLE

ASPECT:
N/A

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.4 AUM/ac

Foothills Rough Fescue - Richardson Needle Grass - FFA23

(Festuca campestris - Stipa richardsonii) Herbaceous

n=8 This is a reference plant community for thin black loamy sites in the Foothills Fescue grassland with strong slopes in the central and northern areas of soil correlation area 5. This community tends to occur on steep slopes above FFA2, but on slopes with more soil development than thin breaks. Richardson needle grass serves as an indicator of steep exposed slopes and also proximity to Montane growing conditions. With heavy grazing pressure, rough fescue is replaced by Richardson needle grass and Idaho fescue and numerous forb species. Litter management may be an important issue on these exposed slopes. This site type is vulnerable to trampling and hoof shear by livestock and ungulates.

Soil Exposure: 4 % (1-19)**Moss/Lichen Cover:** 1 % (0-4) **Total Vegetation:** 90% (72 - 98%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
CREEPING JUNIPER *(Juniperus horizontalis)*	1	0-8	25
FORBS			
THREE-FLOWERED AVENS *(Geum triflorum)*	3	0-13	50
GRASSES			
FOOTHILLS ROUGH FESCUE *(Festuca campestris)*	34	13-55	100
RICHARDSTON NEEDLE GRASS *(Stipa richardsonii)*	12	6-19	100
UNDIFFERENTIATED SEDGE *(Carex)*	7	3-12	100
IDAHO FESCUE *(Festuca idahoensis)*	7	0-13	88
PARRY OAT GRASS *(Danthonia parryi)*	6	0-19	75
NORTHERN WHEAT GRASS *(Agropyron dasystachyum)*	5	1-10	100
CALIFORNIA OAT GRASS *(Danthonia californica)*	3	0-9	75
JUNE GRASS *(Koeleria macrantha)*	2	0-9	63
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	1	0-3	50

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY 2 - STEEP SLOPES

SOILS:
ORTHIC BLACK (BEAZER, STANDOFF)

ELEVATION (M):

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
STRONG
VERY STRONG
MODERATE

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	

Ecologically Sustainable Stocking Rate
0.40 AUM/ac

Foothills Rough Fescue - Northern and Western Wheat Grass - FFA24

(Festuca campesteris -Agropyron dasystachyum and smithii) Herbaceous

n=20 This is the reference plant community for black loamy soils in the Foothills Fescue prairie in the Cardston Plain and Del Bonita Plateau, particularly in the eastern portions adjoining the mixedgrass prairie. Soils are medium textured, well drained with Orthic Black Chernozems and surface Ah horizons less than 20 cm in thickness (often 10 - 15 cm). This community type also occurs on clayey range sites where a higher proportion of wheatgrasses would be expected. This community type occurs on very similar soils to FFA1 and in close transition to the Mixedgrass subregion. With heavy grazing pressure, rough fescue is replaced by wheatgrass species, especially Western wheatgrass which appears to be somewhat better adapted to disturbance than Northern wheatgrass. This plant community has slightly more soil exposure as well as moss/lichen cover than FFA2 or FFA5. Winter Chinook winds expose this grassland type and it is commonly used for winter grazing a practice, which serves to maintain a high abundance of rough fescue. In this drier variant of the foothills rough fescue community, litter management is important to maintain
moisture retention on the site.

Soil Exposure: 9 % (1-24)**Moss/Lichen Cover:** 7 % (2-26) **Total Vegetation:** 89% (68 - 98%)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Creeping Juniper (*Juniperus horizontalis*)	5	0-24	45
Buckbrush (*Symphoricarpos occidentalis)*	4	0-18	70
Prairie Rose (*Rosa arkansana)*	1	0-4	50
Forbs			
Pasture Sagewort (*Artemisia frigida)*	2	0-7	70
Grasses			
Foothills Rough Fescue (*Festuca campestris)*	36	24-54	100
Undifferentiated Wheatgrass (*Agropyron)*	15	3-29	100
Kentucky Bluegrass (*Poa pratensis)*	4	0-20	50
June Grass (*Koeleria macrantha)*	3	0-10	75
Awnless Brome (*Bromus inermis)*	3	0-21	35
Green Needle Grass (*Stipa viridula)*	3	0-19	40
Western Porcupine Grass (*Stipa curtiseta)*	2	0-9	70
Bluebunch Wheat Grass (*Agropyron spicatum)*	2	0-11	35

Environmental Variables

Range Site:
Loamy 4 and Clayey

Soils:
Orthic Black (Beazer, Cowley)

Elevation (m):
1250 to 1300

Soil Drainage:
Well drained

Slope :
Level to Strongly Sloping

Aspect:
Variable

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available)
Total	Not Available

Ecologically Sustainable Stocking Rate
0.4 Aum/ac

Northern and Western Wheat Grass - Foothills Rough Fescue - FFA25

(Agropyron dasystachyum and smithii- Festuca campesteris -) Herbaceous

n=82 This is the mid to late seral plant community on black loamy soils in the Foothills Fescue prairie in the Cardston Plain and Del Bonita Plateau, particularly in the eastern portions adjoining the mixedgrass prairie. Soils are medium textured, well drained with Orthic Black Chernozems and surface Ah horizons less than 20 cm in thickness (often 10 - 15 cm). This community type also occurs on clayey range sites where a higher proportion of wheatgrasses would be expected. With heavy grazing pressure, rough fescue is replaced by wheatgrass species, June grass and fringed sage. This plant community expresses more bare soils and less total vegetation as compared to FFA24, the reference plant community type for this ecological site. Winter Chinook winds expose this grassland type and it is commonly used for winter grazing a practice, which serves to maintain a high abundance of rough fescue. In this drier variant of the foothills rough fescue community, litter management is important to maintain moisture retention on the site.

Soil Exposure: 23 % (1-55)**Moss/Lichen Cover:** 4 % (0-17) **Total Vegetation:** 79% (58-98%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
CREEPING JUNIPER (*Juniperus horizontalis*)	3	0-21	26
BUCKBRUSH (*Symphoricarpos occidentalis*)	2	0–12	45
PRAIRIE ROSE (*Rosa arkansana*)	1	0-12	54
FORBS			
PASTURE SAGEWORT (*Artemisia frigida*)	6	0-23	96
NARROW-LEAVED VETCH (*Vicia americana*)	1	0-5	40
GRASSES			
UNDIFFERENTIATED WHEATGRASS (Agropyron)	25	4-61	100
JUNE GRASS (*Koeleria macrantha*)	11	1-25	100
FOOTHILLS ROUGH FESCUE (*Festuca campestris*)	9	0-29	79
GREEN NEEDLE GRASS (*Stipa viridula*)	8	0-32	82
WESTERN PORCUPINE GRASS (Stipa curtiseta)	5	0-21	71
THREAD-LEAVED SEDGE (*Carex filifolia*)	3	0-21	73
KENTUCKY BLUEGRASS (*Poa pratensis*)	3	0-21	45
AWNLESS BROME (*Bromus inermis*)	2	025	24
SUN-LOVING SEDGE (*Carex pensylvanica*)	1	0-14	45

Environmental Variables

RANGE SITE:
LOAMY 4 AND CLAYEY

SOILS:
ORTHIC BLACK (BEAZER, COWLEY)

ELEVATION (M):
1250 TO 1300

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
LEVEL TO STRONGLY SLOPING

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE)
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.35 AUM/ac

Smooth Brome Northern and Western Wheatgrass - FFA26

(Bromus inermis Agropyron dasystachyum and smithii) Herbaceous

n=9 This is a highly disturbed mid-seral plant community on black loamy soils in the Foothills Fescue prairie in the Cardston Plain and Del Bonita Plateau, particularly in the eastern portions adjoining the mixedgrass prairie. Soils are medium textured, well drained with Orthic Black Chernozems and surface Ah horizons less than 20 cm in thickness (often 10 - 15 cm). This community type occurs on very similar soils to FFA1 and in close transition to the Mixedgrass subregion. In this community, disturbance pressure from heavy grazing has resulted in a major decline in rough fescue, a significant increase in disturbance species like Smooth brome, Western wheatgrass which appears to be somewhat better adapted to disturbance than Northern wheatgrass. This plant community has more soil exposure than the reference plant community FFA24. This community type has diminished value for winter grazing but can still be managed for vigor and productivity and to protect the soil against accelerated erosion. Litter management will be more of challenge as the proportion of native species declines and are replaced by "soft" grasses like Smooth brome that are prone to weathering loss from the elements.

Soil Exposure: 18 % (2-43) **Moss/Lichen Cover:** 2 % (0-4) **Total Vegetation:** 85% (65-98)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
PRAIRIE ROSE			
(*Rosa arkansana*)	2	0-14	33
FORBS			
PASTURE SAGEWORT			
(Artemisia frigida)	3	0-8	89
ALFALFA			
(Medicago sativa)	2	0-10	22
HOARY CRESS			
(Cardaria chalepensis)	1	0-4	22
GRASSES			
AWNLESS BROME			
(Bromus inermis)	30	17-62	100
UNDIFFERENTIATED WHEATGRASS			
(Agropyron)	23	7-40	100
GREEN NEEDLE GRASS			
(Stipa viridula)	16	0-41	89
JUNE GRASS			
(Koeleria macrantha)	6	0-20	89
KENTUCKY BLUEGRASS			
(Poa pratensis)	5	0-17	67
WESTERN PORCUPINE GRASS			
(Stipa curtiseta)	1	0-4	22
UNDIFFERENTIATED SEDGE			
(Carex)	1	0-3	44
THREAD-LEAVED SEDGE			
(Carex filifolia)	1	0-3	22

Environmental Variables

RANGE SITE:
LOAMY 4 AND CLAYEY

SOILS:
ORTHIC BLACK (BEAZER, COWLEY)

ELEVATION (M):
1250 TO 1300

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
LEVEL TO STRONGLY SLOPING

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE)
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0. 32 AUM/ac

Northern and Western Wheatgrass - Green Needle Grass FFA27

(Agropyron dasystachyum and smithii - Stipa viridula) Herbaceous

n=10 This is the reference plant community for strong to steeply sloping loamy soils in the Foothills Fescue prairie in the Cardston Plain and Del Bonita Plateau. This community is associated with the dry transition area to the mixedgrass subregion with a variety of associated species present including green needle grass, western porcupine grass, needle-and-thread grass and June grass. Ground juniper is an indicator of steep slopes and sandgrass may be locally abundant where weathered sandstone has resulted in pockets of sandy soil. With steep slopes, a higher component of exposed soil should be expected for this plant community.

Soil Exposure: 25 % (6-46) **Moss/Lichen Cover:** 2 % (2-3) **Total Vegetation:** 75% (60-94)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
BUCKBRUSH (*Symphoricarpos occidentalis*)	4	0-12	70
PRAIRIE ROSE (*Rosa arkansana*)	2	0-8	80
FORBS			
PASTURE SAGEWORT (*Artemisia frigida*)	7	0-16	80
GRASSES			
UNDIFFERENTIATED WHEATGRASS (*Agropyron*)	21	7-34	100
GREEN NEEDLE GRASS (*Stipa viridula*)	10	0-23	90
WESTERN PORCUPINE GRASS (*Stipa curtiseta*)	8	0-30	70
JUNE GRASS (*Koeleria macrantha*)	7	1-24	100
FOOTHILLS ROUGH FESCUE (*Festuca campestris*)	3	0-28	50
THREAD-LEAVED SEDGE (*Carex filifolia*)	4	0-11	80
NEEDLE-AND-THREAD (*Stipa comata*)	4	0-22	40
KENTUCKY BLUEGRASS (*Poa pratensis*)	3	0-12	50
SAND GRASS (*Calamovilfa longifolia*)	2	0-16	20

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY 4 - STEEP SLOPES

SOILS:
ORTHIC BLACK CHERNOZEM (BEAZER, COWLEY, NORTH FORK, OCKEY)

ELEVATION:
1200- 1350 M

SOIL DRAINAGE:
WELL DRAINED
RAPIDLY DRAINED

SLOPE :
STRONG TO STEEPLY SLOPING

ASPECT:
SOUTHERLY
EASTERLY

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Suggested Carrying Capacity
0..32 AUM/ac

Green Needle Grass - Fringed Sage FFA28

(Stipa viridula - Artemesia frigida) Herbaceous

n=3 This is mid-seral plant community for strong to steeply sloping loamy soils in the Foothills Fescue prairie in the Cardston Plain and Del Bonita Plateau and is associated with FFA27, the reference plant community for the site. This community is associated with the dry transition area to the mixedgrass subregion. Grazing disturbance has reduced the cover of wheatgrass in this community type and resulted in a much higher cover of fringed sage. With steep slopes, a higher component of exposed soil should be expected for this plant community.

Soil Exposure: 29% (13-46) **Moss/Lichen Cover:** 0 % (0) **Total Vegetation:** 75% (65-88)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
PRAIRIE ROSE *(Rosa arkansana)*	2	1-4	100
FORBS			
PASTURE SAGEWORT *(Artemisia frigida)*	12	7-15	100
GRASSES			
GREEN NEEDLE GRASS *(Stipa viridula)*	37	33-46	100
JUNE GRASS *(Koeleria macrantha)*	11	8-17	100
UNDIFFERENTIATED WHEATGRASS *(Agropyron)*	9	6-13	100
UNDIFFERENTIATED SEDGE *(Carex)*	8	3-17	100
BLUEBUNCH FESCUE *(Festuca idahoensis)*	3	0-9	33
THREAD-LEAVED SEDGE *(Carex filifolia)*	2	0-3	67
SLENDER WHEATGRASS *(Agropyron trachycaulum)*	1	0-4	33

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY 4 - STEEP SLOPES

SOILS:
ORTHIC BLACK CHERNOZEM (BEAZER, COWLEY, NORTH FORK, OCKEY)

ELEVATION:
1200- 1350 M

SOIL DRAINAGE:
WELL DRAINED
RAPIDLY DRAINED

SLOPE :
STRONG TO STEEPLY SLOPING

ASPECT:
SOUTHERLY
EASTERLY

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.25 AUM/ac

Northern and Western Wheatgrass - Rough Fescue FFA29

(Agropyron dasystachyum and smithii and Festuca campestris) Herbaceous

n=20 This the reference plant community on limy rangesites in the Foothills Fescue prairie. Limy range sites tend to be immature or eroded soils with free lime (calcium carbonates) at the soil surface or in the B horizon. Hence growing conditions are limited by soil characteristics with dominant species like Northern and Western wheatgrass. The expected level of soil exposure is considerably higher than for loamy range sites.

Soil Exposure: 20% (3-43) **Moss/Lichen Cover**: 1 % (0-3) **Total Vegetation:** 83% (64-98)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
CREEPING JUNIPER *(Juniperus horizontalis)*	3	0-15	30
BUCKBRUSH *(Symphoricarpos occidentalis)*	2	0-11	55
PRAIRIE ROSE *(Rosa arkansana)*	1	0-10	45
FORBS			
PASTURE SAGEWORT *(Artemisia frigida)*	3	0-16	95
GRASSES			
UNDIFFERENTIATED WHEATGRASS *(Agropyron)*	27	5-61	100
JUNEGRASS *(Koeleria macrantha)*	12	3-34	100
FOOTHILLS ROUGH FESCUE *(Festuca campestris)*	10	0-24	85
GREEN NEEDLE GRASS *(Stipa viridula)*	9	0-27	85
KENTUCKY BLUEGRASS *(Poa pratensis)*	4	0-35	55
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	4	0-15	70
THREAD-LEAVED SEDGE *(Carex filifolia)*	2	0-11	60
AWNLESS BROME *(Bromus inermis)*	2	0-11	30

ENVIRONMENTAL VARIABLES

RANGE SITE:
LIMY

SOILS:
REGO BLACK CHERNOZEMS (PARSONS, OLDMAN)
CALCAREOUS BLACK CHERNOZEMS (COWLEY, MOKOWAN, WOL-AA)

ELEVATION:
1200 - 1350 M

SOIL DRAINAGE:
WELL DRAINED
RAPIDLY DRAINED
VERY RAPIDLY DRAINED

SLOPE :
LEVEL TO STRONGLY SLOPING

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.35 AUM/ac

Kentucky Bluegrass - Timothy FFB1

(Poa pratensis - Phleum pratense) Herbaceous

n=38 This community is a modified plant community found on loamy range sites in both the Foothills Fescue and Foothills Parkland Natural Subregions. This plant community is the product of long-term heavy grazing, where rough fescue, Parry oatgrass and native wheatgrasses have been gradually replaced by Kentucky bluegrass and Timothy to a lesser extent. In general, the extent of site's suitable for invasive grasses will be more limiting in the Foothills Fescue grassland compared to foothills parkland, a subregion more favorable to woody plant species due to a lower precipitation to evaporation ratio, and therefore, this community type will be most common on valley bottom and lower slope positions. With proper stocking levels and appropriate rotational grazing practices, the plant community can be quite productive but many values normally associated the native rough fescue communities are diminished including drought resistance and suitability for winter grazing. Based on existing information, there appears to be limited potential for recovery from this community type to one dominated by native graminoids. The Ecologically Sustainable Stocking Rate is set to allow the range health of the plant community to improve. Stocking at .5 to .65 AUM/ac will maintain the existing plant community.

Soil Exposure: 1 % (0-12) **Moss/Lichen Cover:** 0 % (0-5) **Total Vegetation:** 97 % (88-98)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Buckbrush *(Symphoricarpos occidentalis)*	4	0-15	68
Forbs			
Canada Thistle *(Cirsium arvense)*	2	0-12	55
Common Dandelion *(Taraxacum officinale)*	1	0-10	66
Commom Yarrow *(Achillea millefolium)*	1	0-6	82
Grasses			
Kentucky Bluegrass *(Poa pratensis)*	49	27-76	100
Timothy *(Phleum pratense)*	9	0-34	87
Foothills Rough Fescue *(Festuca campestris)*	3	0-15	58
Northern Wheat Grass *(Agropyron dasystachyum)*	2	0-11	45
Northern Awnless Brome *(Bromus inermis* spp.*)*	2	0-33	53
Parry Oat Grass *(Danthonia parryi)*	2	0-9	63
Awned Wheat Grass *(Agropyron subsecundum)*	2	0-7	84
Sedge *(Carex spp.)*	2	0-12	66

Environmental Variables

Range Site:
Loamy 1

Soils:
Orthic Black chernozem
(Beazer, Standoff)

Elevation (m):

Soil Drainage:
Moderately Well Drained
Well Drained

Slope :
Very Gentle
Moderate
Gentle

Aspect:
Variable

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available
Total	Not Available

Ecologically Sustainable Stocking Rate
0.40 AUM/ac

Kentucky Bluegrass - Fringed Sage FFB2

(Poa pratensis - Artemisia frigida) Shrub Herbaceous

n= 3 This community is a highly modified plant community found on loamy range sites in the Cardston Plain in the Foothills Fescue Natural Subregion. This plant community is the product of long-term heavy grazing, where rough fescue and Parry oatgrass have been gradually replaced by Kentucky bluegrass and disturbance induced increasers like pasture sage. Further indicators of degradation include bare soil at 36% and vegetation canopy at about 44%. Risk of soil loss from this site will be significantly increased. With proper stocking levels and appropriate rotational grazing practices, the plant community can be quite productive but many values normally associated the native rough fescue communities are diminished including drought resistance and suitability for winter grazing. Based on existing information, there appears to be limited potential for recovery from this community type to one dominated by native graminoids. The suggested stocking rate will allow the range health of the plant community to improve. Stocking at .4 to .55 AUM/ac will serve to maintain the existing plant community.

Soil Exposure: 36% (15-48) **Moss/Lichen Cover:** 1 % (1 - 2)**Total Vegetation:** 44% (35 - 53%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
PRAIRIE ROSE (*Rosa arkansana*)	1	0-3	33
FORBS			
PASTURE SAGE (*Artemisia frigida*)	16	12-19	100
LEAFY SPURGE (*Euphorbia esula*)	2	0-6	33
COMMON DANDELION (*Taraxacum officinale*)	2	0-5	33
COMMON YARROW (*Achillea millefolium*)	1	0-2	33
GRASSES			
KENTUCK BLUEGRASS (*Poa pratensis*)	65	52-78	100
NORTHERN WHEATGRASS (*Agropyron dasystachyum*)	4	0-6	67
AWNLESS BROME (*Bromus inermis*)	4	0-7	67
JUNE GRASS (*Koeleria macrantha*)	1	0-2	67
WESTERN PORCUPINE GRASS (*Stipa curtiseta*)	0	0-1	67

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY 2

SOILS:
ORTHIC BLACK CHERNOZEM (BEAZER, STANDOFF,CARDSTON)

ELEVATION:
M

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
VERY GENTLE
GENTLE

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Suggested Grazing Capacity
0.3 AUM/ac

Smooth Brome - Alfalfa FFB3

(Bromus inermis - Medicago sativa) Herbaceous

n=13 This an old field plant community associated with loamy range sites in the Foothills Fescue prairie, in the vicinity of the Oldman Reservoir near north of Brocket and Pincher Creek. These fields were once seeded as hay or pastureland but now are managed as pastureland. This community would rate as a desirable modified plant community given the abundance of Smooth brome and Alfalfa. It is unlikely that this community would revert to native status, but there are a number of native species that have reestablished with the agronomic species. This community will produce little forage during drought periods and are not well suited to dormant season grazing. Plant vigor should be maintained to prevent weed invasion. Soil exposure is greater than found in the reference plant community.

Soil Exposure: 32 % (2-60) **Moss/Lichen Cover:** 0 **Total Vegetation:** 72% (42-93)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
PRAIRIE ROSE *(Rosa arkansana)*	4	0-20	69
FORBS			
ALFALFA *(Medicago sativa)*	18	0-41	92
COMMON DANDELION *(Taraxacum officinale)*	3	0-15	46
CANADA THISTLE *(Cirsium arvense)*	1	0-5	38
CREEPING WHITE PRAIRIE ASTER *(Aster falcatus)*	1	0-5	31
YELLOW SWEET-CLOVER *(Melilotus officinalis)*	1	0-8	8
GRASSES			
AWNLESS BROME *(Bromus inermis)*	41	17-92	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	3	0-16	62
KENTUCKY BLUEGRASS (Poa pratensis)	3	0-20	31
RED FESCUE *(Festuca rubra)*	1	0-8	31
GREEN NEEDLE GRASS *(Stipa viridula)*	1	0-13	8

Environmental Variables

RANGE SITE
LOAMY 4 AND CLAYEY

SOILS
ORTHIC BLACK (BEAZER, COWLEY)

ELEVATION (M):
1250 TO 1300

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
LEVEL TO STRONGLY SLOPING

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE)
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.35 AUM/ac

Kentucky Bluegrass - Smooth Brome - Northern and Western Wheatgrass - FFB4

(Poa pratensis - Bromus inermis Agropyron dasystachyum and smithii) Herbaceous

n=6 This is a modified plant community on dry loamy soils in the Foothills Fescue grassland in the Cardston Plain and Del Bonita Plateau. This is a modified plant community to FFA24 and is associated with the transition area to the mixedgrass prairie. This plant community is most likely the result of heavy grazing pressure over a prolonged period but may also be old field communities once seeded for tame pasture or hay and now managed as rangeland pasture. It is unlikely that this community would revert to native status, but there are a number of native species that have reestablished with the agronomic species. This community will produce little forage during drought periods and are not well suited to dormant season grazing. Plant vigor should be maintained to prevent weed invasion. Soil exposure is increased over the reference plant community.

Soil Exposure: 14% (5-33) **Moss/Lichen Cover:** 4 % (0 - 7) **Total Vegetation:** 89% (69-98)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
BUCKBRUSH (*Symphoricarpos occidentalis*)	7	0-18	50
PRAIRIE ROSE *(Rosa arkansana)*	3	0-13	33
SASKATOON *(Amelanchier alnifolia)*	2	0-5	33
FORBS			
ALFALFA *(Medicago sativa)*	3	0-15	17
CANADA THISTLE *(Cirsium arvense)*	2	0-11	33
PRAIRIE SAGEWORT *(Artemisia ludoviciana)*	1	0-3	50
COMMON DANDELION *(Taraxacum officinale)*	1	0-4	50
GRASSES			
KENTUCKY BLUEGRASS *(Poa pratensis)*	32	18-53	100
AWNLESS BROME *(Bromus inermis)*	28	15-40	100
UNDIFFERENTIATED WHEATGRASS *(Agropyron)*	7	2-19	100
CANADA BLUEGRASS *(Poa compressa)*	2	0-11	17
QUACK GRASS *(Agropyron repens)*	2	0-5	33

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY 1

SOILS:
ORTHIC BLACK (BEAZER, DEL BONITA, STANDOFF)

ELEVATION (M):

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
STRONG, MODERATE

ASPECT:
N/A

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.32 AUM/ac

Raspberry-Rose/Kentucky Bluegrass - Dandelion FFC1

(Rubus idaeus - Rosa woodsii / Poa pratensis - Taraxacum officinale) Shrub Herbaceous

n=10 This is a highly disturbed, early seral plant community associated with wetland and moist loamy range sites in the Foothills Fescue and foothills parkland Natural Subregions. Site determination is difficult given the subtle transition from upland to riparian conditions. It is more common in the foothills parkland Natural Subregion, but can be found in wetland and moist valley bottom locations in the Foothills Fescue. This community has been significantly modified by disturbance history leading to the replacement of tufted hair grass and sedges by a variety of non-native species including Kentucky bluegrass, Timothy, Canada thistle, dandelion and quack grass, thus diminishing the values and functions of the plant community. Heavy grazing can modify the plant community and reduce the depth and quality of the turfy surface layer. This in turn reduces the potential moisture holding capacity and water infiltration into the soil, and, increases overall runoff. The range site may appear to be more of a loamy upland site when the dominance of riparian species is diminished. The potential to restore this plant community to native condition appears very limited at this time, but productivity and vegetation cover can be significantly enhanced through rotational grazing. Though the potential for recovery of the herbaceous layers appears unlikely, there are many woody species that may release with more rest in the grazing cycle including: basket willow, Saskatoon, chokecherry, gooseberry and aspen. The Ecologically Sustainable Stocking Rate will allow range health to improve. Stocking at .7 to .9 AUM/ac will maintain the existing plant community.

Soil Exposure: 1 % (0-10) **Moss/Lichen Cover:** 1% (0-4) **Total Vegetation:** 98% (98-98)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Wild Red Raspberry *(Rubus idaeus)*	7	0-40	90
Common Wild Rose *(Rosa woodsii)*	7	0-16	90
Snowberry *(Symphoricarpos albus)*	4	0-13	80
Forbs			
Common Dandelion *(Taraxacum officinale)*	7	3-15	100
Wild White Geranium *(Geranium richardsonii)*	3	2-8	100
Grasses			
Kentucky Bluegrass *(Poa pratensis)*	15	1-48	100
Timothy *(Phleum pratense)*	6	0-9	100
Bluejoint *(Calamagrostis canadensis)*	4	0-12	50
Undifferentiated Sedge *(Carex)*	3	0-8	90
Fowl Bluegrass *(Poa palustris)*	3	0-14	60
Tufted Hair Grass *(Deschampsia cespitosa)*	1	0-3	60

Environmental Variables

Range Site:
Loamy 1, Wetland, overflow

Soils:
Orthic Humic Gleysol
Orthic Black Chernozem

Elevation:

Soil Drainage:
Poorly drained, Imperfectly drained
Moderately well drained
well drained

Slope :
Very gentle, Nearly level
Moderate

Aspect:
Northerly

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available
Total	Not Available

Ecologically Sustainable Stocking Rate
0.5 AUM/ac

Beaked Willow/Sedge - Tufted Hair Grass FFC2

(Salix bebbiana / Carex - Deschampsia cespitosa) Herbaceous Shrub

n=6 This is a late seral to reference plant community for wetlands and subirrigated range sites in the Foothills Fescue grassland. This community is more common in the adjoining foothills parkland Natural Subregion, but can be found in wetland and moist valley bottom locations in the Foothills Fescue. The moist rich growing conditions of the site are easy to recognize given the presence of beaked willow and the dominance of sedges and tufted hair grass. Heavy grazing can modify the plant community and reduce the depth and quality of the turfy surface layer. This in turn reduces the potential moisture holding capacity and soil moisture infiltration and increases overall runoff. The range site may appear to be more of a loamy upland site when the dominance of riparian species is diminished. This is a highly productive plant community that can be maintained with rotational grazing practices. Season long grazing, even at proper stocking rates for the overall pasture will allow this type to become preferred range leading to declines in range health and productivity over time.

Soil Exposure: 0 % (0-1) **Moss/Lichen Cover:** 2% (0-9) **Total Vegetation:** 97% (96-98)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Beaked Willow *(Salix bebbiana)*	3	0-15	17
Undifferentiated Willow *(Salix)*	2	0-5	67
Forbs			
Canada Thistle *(Cirsium arvense)*	2	0-9	83
Common Dandelion *(Taraxacum officinale)*	2	0-3	100
Grasses			
Undifferentiated Sedge *(Carex)*	25	16-37	100
Tufted Hair Grass *(Deschampsia cespitosa)*	17	10-25	100
Undifferentiated Reed Grass *(Calamagrostis)*	8	0-25	33
Narrow Reed grass *(Calamagrostis stricta)*	7	0-27	50
Wire Rush *(Juncus balticus)*	7	2-14	100
Kentucky Bluegrass *(Poa pratensis)*	5	0-10	83
Timothy *(Phleum pratense)*	5	0-13	83

Environmental Variables

Range Site:
- Sub-Irrigated, Wetland
- overflow

Soils:
- Orthic Humic Gleysol
- Orthic Black Chernozem

Elevation:

Soil Drainage:
- Poorly drained
- Imperfectly drained

Slope :
- Gentle, Level
- Very gentle
- Nearly level

Aspect:
- Southerly

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available
Total	Not Available

Ecologically Sustainable Stocking Rate
1.3 AUM/ac

Beaked Willow/Kentucky Bluegrass -Timothy - Tufted Hair Grass - FFC3

(Salix bebbiana/Poa pratensis - Phleum pratense - Deschampsia cespitosa) Shrub Herbaceous

n=7 This an early to mid seral plant community in the Foothills Fescue grassland on wetland and very moist loamy range sites. Site determination is difficult given the subtle transition from upland to riparian conditions. It is more common in the foothills parkland Natural Subregion, but can be found in wetland and moist valley bottom locations in the Foothills Fescue. This community has been significantly modified by disturbance history leading to the replacement of tufted hair grass and sedges by a variety of non-native species including Kentucky bluegrass, Timothy, Canada thistle, dandelion, awnless brome and meadow fescue, thus diminishing the values and functions of the plant community.

Soil Exposure: 1% (0-5) **Moss/Lichen Cover:** 1% (0- 4) **Total Vegetation:** 97% (94-98%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
BEAKED WILLOW (Salix *bebbiana*)	4	0-29	14
SHRUBBY CINQUEFOIL *(Potentilla fruticosa)*	1	0-4	43
FORBS			
CANADA THISTLE *(Cirsium arvense)*	3	0-12	57
COMMON DANDELION *(Taraxacum officinale)*	2	0-6	100
GRASSES			
KENTUCKY BLUEGRASS *(Poa pratensis)*	25	13-49	100
TIMOTHY *(Phelum pratense)*	13	3-26	100
TUFTED HAIR GRASS *(Deschampsia cespitosa)*	9	1-15	100
SEDGE *(Carex spp.)*	5	0-24	57
AWNLESS BROME *(Bromus inermis)*	4	0-28	14
MEADOW FESCUE *(Festuca pratensis)*	4	0-25	14
WIRE RUSH *(Juncus balticus)*	3	0-11	86
HOOKER'S SEDGE *(Carex hookerana)*	2	0-10	29

ENVIRONMENTAL VARIABLES

RANGE SITE:
- WETLAND
- LOAMY (MOIST)

SOILS:
- ORTHIC HUMIC GLEYSOL
- GLEYED BLACK CHERNOZEM

ELEVATION ():

SOIL DRAINAGE:
- MODERATELY WELL DRAINED
- IMPERFECTLY DRAINED
- POORLY DRAINED

SLOPE :
- NEARLY LEVEL
- VERY GENTLE

ASPECT:
- SOUTHERLY
- NORTHERLY

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Suggested Grazing Capacity
0.8 AUM/ac

Creeping Juniper - Parry Oatgrass - Western Porcupine Grass - FFC4

(Juniperus horizontalis - Danthonia parryi - Stipa curtiseta) Shrub Herbaceous

n=1 This is a preliminary community that is likely the reference plant community on the steepest of thin break range sites within the Foothills Fescue Natural Subregion. This community is common on steep ridges and very strong slopes where juniper will form dense colonies through a strong spreading root system.

Soil Exposure: 10% **Moss/Lichen Cover:**10% **Total Vegetation:**87%

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
CREEPING JUNIPER (*Juniperus horizontalis*)	39		
FORBS			
CREEPING WHITE PRAIRIE ASTER (*Aster falcatus*)	4		
COMMON YARROW (*Achillea millefolium*)	1		
GRASSES			
PARRY OAT GRASS (*Danthonia parryi*)	23		
WESTERN PORCUPINE GRASS (*Stipa curtiseta*)	7		
UNDIFFERENTIATED SEDGE (*Carex*)	4		
HOOKER'S OAT GRASS (*Helictotrichon hookeri*)	4		
FOOTHILLS ROUGH FESCUE (*Festuca campestris*)	3		
IDAHOE FESCUE (*Festuca idahoensis*)	3		
JUNE GRASS (*Koeleria macrantha*)	2		
NORTHERN WHEATGRASS (*Agropyron dasystachyum*)	2		

ENVIRONMENTAL VARIABLES

RANGE SITE:
THIN BREAKS

SOILS:
ORTHIC EUTRIC BRUNISOL (NORTH FORK)
ORTHIC BLACK CHERNOZEM (OCKEY)

ELEVATION:
M

SOIL DRAINAGE:
WELL DRAINED
RAPIDLY DRAINED

SLOPE :
VERY STRONG

ASPECT:
SOUTHWEST

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.2 AUM/ac

Snowberry/Smooth Brome - Kentucky bluegrass FFC5

(Festuca idahoensis - Festuca campestris - Koeleria macrentha) Herbaceous

n=21 This plant community is disturbed shrub community that is associated with limy range sites, but occurs on moderate to steep north and east facing slopes. Aspect and winter snow deposition provide moist growing conditions which are suitable for Smooth brome and Kentucky bluegrass to invade and persist on the site. These sites may also be vulnerable to deposition of weed seeds like Canada thistle, which may become established with the superior moisture regime.

Soil Exposure: 9 % (2-20) **Moss/Lichen Cover:** 0% (0-0) **Total Vegetation:** 89% (20 - 100)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
BUCKBRUSH *(Symphoricarpos occidentalis)*	13	0-34	81
SASKATOON *(Amelanchier alnifolia)*	2	0-24	38
FORBS			
COMMON YARROW *(Achillea millefolium)*	2	0-11	43
SMOOTH ASTER *(Aster laevis)*	2	0-19	19
COMMON DANDELION *(Taraxacum officinale)*	1	0-8	24
ALFALFA *(Medicago sativa)*	1	0-20	10
GRASSES			
AWNLESS BROME *(Bromus inermis)*	60	17-96	100
KENTUCKY BLUEGRASS *(Poa pratensis)*	7	0-37	52
GIANT WILD RYE *(Elymus piperi)*	2	0-14	24

ENVIRONMENTAL VARIABLES

RANGE SITE:
LIMY

SOILS:
REGO BLACK CHERNOZEMS (PARSONS, OLDMAN)
CALCAREOUS BLACK CHERNOZEMS (COWLEY, MOKOWAN, WOL-AA)

ELEVATION:
1200 - 1350 M

SOIL DRAINAGE:
WELL DRAINED
RAPIDLY DRAINED

SLOPE :
MODERATE TO SEEP SLOPES

ASPECT:
NORTH AND EAST

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	NOT AVAILABLE
TOTAL	NOT AVAILABLE

Ecologically Sustainable Stocking Rate
0.25 AUM/ac

Creeping Juniper/Northern and Western Wheat Grass FFC6

(Juniperus horizontalis/Agropyron dasystachyum and smithii) Herbaceous

n=10 This is a reference plant community for thin break range sites in the Foothills Fescue prairie within the Cardston Plain and Del Bonita Plateau. This community is a product of dry and exposed slope conditions. Thin break range sites are steeply sloping landscapes with less than 10% bedrock exposure and with bedrock within 5 m of the soil surface. Soil exposure is very high given the steepness and exposure of slopes.

Soil Exposure: 38 % (10-58) **Moss/Lichen Cover:** 2% (0-3) **Total Vegetation:** 65% (50-90)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Creeping juniper *(Juniperus horizontalis)*	28	13-41	100
Saskatoon *(Amelanchier alnifolia)*	4	0-23	40
Buckbrush *(Symphoricarpos occidentalis)*	3	0-11	70
Skunkbush *(Rhus trilobata)*	2	0-7	50
Forbs			
Golden Bean *(Thermopsis rhombifolia)*	1	0-9	40
Grasses			
Undifferentiated wheatgrass *(Agropyron)*	21	5-34	100
Bluebunch wheatgrass *(Agropyron spicatum)*	6	0-25	50
Green needle grass *(Stipa viridula)*	4	0-8	90
June grass *(Koeleria macrantha)*	3	0-5	80
Thread-leaved sedge *(Carex filifolia)*	2	0-7	70
Foothills rough fescue *(Festuca campestris)*	2	0-15	40
Indian rice grass *(Oryzopsis hymenoides)*	1	0-9	30
Plains muhly *(Muhlenbergia cuspidata)*	1	0-4	50

Environmental Variables

Range Site:
Thin Breaks

Soils:
Orthic Regosol
(North Fork, Ockey, Mokowan, Owendale)

Elevation:
1200 - 1350 m

Soil Drainage:
Well drained
Rapidly drained

Slope :
Steeply Sloping

Aspect:
South and West

Forage Production (lb/ac)

Grass	Not Available
Forb	Not Available
Shrub	Not Available
Litter	Not Available
Total	Not Available

Ecologically Sustainable Stocking Rate
0.28 AUM/ac

7.0 Guidelines for assessing plant community structure, soil exposure and litter abundance and noxious weeds.

The following guidelines are designed for use with the Range Health Assessment for Grassland, Forest and Tame Pastures - Field Workbook (Adams et al. 2003). The range health protocol is available from the Rangeland Management Branch, Public Lands Division, Alberta Sustainable Resource Development as a field workbook in 2003. The following comments are to assist the user in interpreting the range health codes and instructions in the Foothills Fescue grassland.

7.1 Question 1 Integrity and Ecological Status

Why is plant species composition important?

Plant species composition is a fundamental consideration in range health assessment. Plant species composition will influence a site's ability to perform functions and provide products and services. Native plant communities evolve within their environment and slowly change over time as environmental factors change. Significant short term changes in plant composition do not normally occur unless caused by significant disturbances like continuous heavy grazing, prolonged drought, prolonged high periods of precipitation, exotic species invasion, frequent burning or a timber harvesting treatment.

What changes in plant community may result from disturbance?

- Plant species changes due to grazing pressure are predictable:
  Perennial species that tend to be most productive and palatable are also the most sensitive to grazing and will decline with increased grazing pressure.
  Species with lower forage value and greater adaptation to grazing pressure will increase in relative abundance.
  Eventually very heavy grazing pressure will lead to weedy species that are adapted to more constant levels of disturbance.

What successional stages should we manage for?

Range management objectives tend to favor the later stages of plant succession (late-seral to reference plant community or good to excellent range condition). Late-seral plant communities tend to be superior in the efficient capture of solar energy, in cycling of organic matter and nutrients, in retaining moisture, in supporting wildlife habitat values and in providing the highest potential productivity for the site. Early-seral stages represent plant communities with diminished ecological processes that are less stable and more vulnerable to invasion by weeds and non-natives species. They are also characterized by diminished resource values such as livestock forage production, wildlife habitat values and watershed protection.

How do management changes affect plant communities?

When disturbance impacts are reduced or removed, the present plant community may react in a number of ways. It may appear to remain static, or it may move toward a number of identifiable plant communities, including the potential natural community. Some rangeland communities due to disturbance history or a natural process of invasion, have become dominated by non-native species called modified plant communities. To the best of our knowledge, long-term rest of these modified plant communities will not return these to native plant communities. When non-native plant communities are being evaluated (not including tame pasture at this time), a separate set of questions are applied to determine the health status of modified plant communities.

How can I tell the ecological status of a plant community?

The plant community tables provide guidance in understanding the ecological status of a given plant community:

- The range plant community column normally contains plant communities considered to be the Reference Plant Community(RPC) or site potential.
- The next column to the right shows plant communities that are seral. These communities have had some modification due to disturbance with seral status declining as you move down the column.
- The next column to the right of the seral communities column summarizes seral modified communities where disturbance history has altered the plant communities to a non-native or modified status.

7.2 Question 2 - Plant Community Structure

What is plant community structure and why is it important?

This parameter recognizes the importance of structure associated with the canopy cover of major life form groups (trees, shrubs, forbs and graminoids) in a plant community. A diverse plant community supports optimum nutrient cycling and energy flow. Different life forms or life form groups vary in canopy structure and rooting depths, using sunlight, water and nutrients from different zones in the vegetation canopy and soil. Plant community structure is important in maintaining net primary production, especially in forested rangelands, and in the maintenance of habitat values for a spectrum of wildlife species including browsing opportunities for ungulates and feeding and nesting sites for breeding birds. In grasslands plant community structure also contributes to snow capture and retention.

Scoring structure in the Foothills Fescue grassland

- rough fescue grassland will normally have a tall grass and forb layer including rough fescue, a number of native wheatgrasses and a number of tall forbs
- Parry oatgrass and Idaho fescue will identify a mid-grass structural layer
- healthy Foothills Fescue grasslands normally have a rich layer of low grasses and low forbs filling in the spaces in the canopy between the larger bunchgrasses

- this layer of low graminoids and forbs may be shaded out in the absence of grazing
- when rating structure in modified plant communities, tall growing non-natives (Kentucky bluegrass, awnless brome and Timothy) may receive full marks for structure if they provide a canopy height similar to a healthy rough fescue stand

7.3 Question 3 - Does the site retain moisture (litter standards)

What is litter and how does it contribute to range health?

When functioning properly, a watershed captures, stores and beneficially releases the moisture associated with normal precipitation events. Uplands make up the largest part of the watershed and are where most of the moisture received during precipitation events is captured and stored. Live plant material from both vascular and non-vascular plants and **litter,** residual plant material, either standing, freshly fallen or slightly decomposed on the soil surface, is strongly linked to range health. Litter cover aids a number of important functions on rangeland including: water infiltration (slowing runoff and creating a path into the soil), reducing soil erosion from wind and water, reducing evaporative losses and reducing raindrop impact.

In grassland environments significant incoming precipitation is lost as evapo-transpiration. Litter acts as a physical barrier to heat and water flow at the soil surface. Litter conserves moisture by reducing evaporation, making scarce moisture more effective. Studies show that forage yields are reduced by about 30 % during dry years when litter has been removed by fire or heavy grazing on foothills rangelands (Willms et. al 1986). Table 3 summarizes litter normals for the Foothills Fescue grassland. Like climate normals, litter normals will be adjusted and refined over time as additional years of monitoring add to the normals.

How much is enough?

Our basic assumption is that healthy grazed sites that provide optimum grazing opportunities will have a characteristic litter level that will be maintained over time with light to moderate stocking rates. By monitoring a variety of different ecological range sites over time, we are able to establish a "litter normal" expressed as lb./ac. The litter normals recommended for the Foothills Fescue grassland are summarized in Table 3. The litter normal relates to the potential productivity of the site.

- Most loamy range sites in the Foothills Fescue grassland will be Orthic Black Chernozems with Ah thickness 20 cm or less. Thick Black describes the deeper profiles that exceed 20 cm in Ah thickness.
- Threshold values should be viewed as a starting point, a minimum level for establishing a basic level of moisture retention.
- While it is possible to have an excessive litter build up that has choking effect on the grassland, this generally occurs at > 4000 - 6000 lb./ac. of litter.
- Modified plant communities have a diminished potential to produce adequate litter levels since the non-native plant material is much more prone to weathering loss.

Table 11. Litter normals for the Foothills Fescue.

Range Site	Litter Normal	Healthy >65% of normal	Healthy with problems 65 to 35% of normal	Unhealthy <35% of normal	Data Source	Litter Values (lb./ac.)	n= years collected
Loamy	1200	>780	780	<420	• Waldron Benchmark Exlosure and Willow Creek Exclosures (Moisey and Adams 2002) • Granum Fire Recovery Study (Bork et. al 2002) • Milk River Exclosure (Moisey and Adams 2002)	1188 928 1209	12 1 12
Shallow-to-Gravel	1000	>650	650-350	<350	• Maycroft Benchmark Exclosure - recovery stage (Moisey and Adams 2001) • Upper Pekisko (Moisey and Adams 2002) • Upper Pekisko(Adams et. al 1992)	720 1664 1200	11 1 3
Thin Breaks	500	>325	325-175	<175	• Ocular estimates (High Range Ecological Consultants - SW Range Surveys)	400 to 600	7 years of single year observations

7.4 Question 4 - Site/Soil Stability

Why is soil loss a concern for rangeland health?

Rangelands experience varying degrees of natural stability depending on climate, soil, topography and plant cover. The normal amount of sediment that will be produced by water and wind erosion processes from a particular site type is termed geologic erosion. Managers strive to prevent accelerated erosion due to land management practices by maintaining adequate vegetation cover and a minimum of exposed soil. Vegetation protects the soil surface from raindrop impact, it detains overland flow, maintains infiltration and permeability and protects the soil surface from erosion. Soil loss is a serious concern since erosion tends to remove the most valuable fractions from the soil, the finer lighter particles like clays, silts and organic matter which are most important to soil fertility and moisture holding capacity. Long-term studies show that ongoing soil loss due to overgrazing or other practices will eventually transform the soil to a shallower, drier, less productive and less stable soil type. Excess sediment production has a negative impact on water quality since the fine particles that are eroded have great potential to absorb and carry nutrients and chemicals.

Ecological sites that are normally unstable will tend to exhibit significant exposed soil and have shallow soil profiles (seepage and slumping areas, badlands, thin breaks, saline

lowlands, solonetzic soils, some sandy soils). Erosion and sediment production from sites that are normally unstable is not the focus of this question, but rather the loss of key soil particles from well developed sites that are normally stable.

Human-caused bare soil is rated by considering the total bare soil on a range site minus the amount that is normally naturally occurring. For most sites in the Foothills Fescue grassland, there is normally no bare soil. The following table shows the normal range of mean soil exposure values observed in the plant community data. Steep slopes, gravelly soils and thin break sites may have up to about 10% naturally occurring bare soil (Table 12).

Table 12. Soil exposure normals for major range sites in the Foothills Fescue grassland.

Range Sites	Soil Exposure (% canopy cover)
Loamy	
• Loamy 1 moist	0-1%
• Loamy 2 mid	0-5%
• Loamy 3 dry	0-8%
• Loamy steep	5-8%
Gravel and Shallow-to-Gravel	5-10%
Thin Breaks	5-10%

7.5 Question 5 - Noxious weed infestation.

Noxious weeds are invasive plants that are alien species to the rangeland plant community. Weeds are seldom a problem in vigorous, well managed pastures although weed invasion may occasionally happen in healthy stands. Weeds may be introduced to relatively healthy stands through rodent burrows, but generally their presence indicates a degrading plant community. Noxious weeds diminish the agricultural productivity of a site, and threaten biological diversity and the structure, function, and sustainability of ecosystems. They diminish the multiple uses and values that range is normally capable of providing.

Weeds normally provide a strong message about range health. Weeds most often invade range where grazing practices have resulted in available niche space (bare soil, surplus moisture); available micro-habitats normally occupied by range plants, but now available to weeds due to overgrazing or some other land use or natural disturbance. Grazing management strives to maintain plant vigor and vegetation cover so that all niche space is filled by one or more plant communities that can occupy the site and thereby minimize weed invasion.

The rating noxious weed infestation should be guided by local weed list of noxious weeds as provided by municipal weed control authorities. This question attempts to identify noxious (restricted weeds) infestation on a range site.

In the analysis of plot data, three noxious weeds were encountered including Canada thistle, leafy spurge and tall buttercup. Several nuisance weeds were also encountered including perennial sow thistle and annual hawk's beard. Canada thistle was the most common occurring in about 15 percent of plots. On highly disturbed sites it occurred at up to 12 % canopy cover. All other weed species occurred at trace levels of frequency and cover.

8.0 Literature cited

Adams, B. W., G. Ehlert, C. Stone, M. Alexander, D. Lawrence, M. Willoughby, D. Moisey, C. Hincz, and A. Bogen. Range Health Assessment for Grassland, Forest and Tame Pasture. Public Lands Division, Alberta Sustainable Resource Development. Pub. No. T/044 105 pp

Adams, G.D., G. Trottier, W. Strong, I.D. McDonald, S.J. Barry, P. Gregoire, G. Babish and G. Weis. 1997. Vegetation Component Report, CFB Suffield - National Wildlife Area, Wildlife Inventory. Canadian Wildlife Service, Edcmonton, 96 pp.

Achuff, P.L., 1994. Natural regions, subregions and natural history themes of Alberta. A classification for protected areas management. Alberta Environmental Protection, Edmonton, Alberta.

Archibald, J.H, G.D. Klappstein and I.G.W. Corns. 1996. Field guide to ecosites of southern Alberta. Nat. Resour. Can., Can. For. Serv., Northwest reg., North. For. Cent., Edmonton Alberta. Spec Rep. 8.

Alberta Soil Information Centre (ASIC) 2001. AGRASID 3.0: Agricultural Region of Alberta Soil Inventory Database (Version 3.0). Edited by J. A, Brierley, T.C. Martin and D.J. Spies. Agriculture and Agri-Food Canada, and Alberta Agriculture, Food and Rural Development, Conservation and Development Branch. Edmonton, Alberta. Available: http://www.agric.gov.ab.ca/asic

Beckingham, J.D. and J.H. Archibald. 1996. Field guide to ecosites of northern Alberta. Nat. Resour. Can., Can. For. Serv., Northwest reg., North. For. Cent., Edmonton Alberta. Spec Rep. 5.

Brierley, J.A., Rodvang, A.T., and Pettapiece, W.W., 1991. Soil Survey of the Municipal District of Cardston (M.D. No. 6), Alberta. Land Resource Research Contribution No. 87-62. Alberta Institute of Pedology Report No. S-86-48. Edmonton, Alberta.

Brown, D. 1997. Smooth brome (*Bromus inermis* Leyss) in Foothills Fescue grassland: stand characterization and the effects of cattle, sheep, mowing, glyphosate and fire. M.Sc. Thesis, University of Alberta, Edmonton, Alberta. 136 pp.

Butler, L.D. 1997. National Range and Pasture Handbook. Grazing Lands Technology Inst, NRCS – USDA, Washington D.C.

Busby, F.E. 1994. Rangeland Health – New Methods to Classify, Inventory and Monitor Rangelands. National Academy of Science Report, National Research Council, Washington D.C. 180 pp.

Chanasyk, D.S., E. Mapfumo and W. Willms. 2002. Quantification and simulation of surface runoff from fescue grassland watersheds. Agric. Water Management 59: 137-153.

Chanasyk, D.S., E. Mapfumo, E., W.D. Willms and M.A. Naeth. Quantification and Simulation of Soil Water on Grazed Fescue Grassland Watersheds J. Range Manage. (In press)

Chetner, S. and the Agroclimatic Atlas Working Group. 2003. Agroclimatic Atlas of Alberta, 1971 to 2000. Alberta Agriculture, Food and Rural Development, Agdex 071-1. Edmonton, Alberta.

Clarke, S.E., J.A.Campbell, and J.B. Campbell. 1942. An ecological and grazing capacity study of the native grass pastures in southern Alberta, Saskatchewan and Manitoba. Canad. Dept. Agric. Tech. Bull., 44.

Coupland, R.T. 1961. A reconsideration of the grassland classification in the northern great plains of North America. Journal of Ecology 49: 135-167.

Dormaar, J.F. and W.D Willms. 1998. Effects of forty-four years of grazing on fescue grassland soils. J. Range Manage. 51:122-126.

Dormaar, J.F., and W.D. Willms. 1990. Sustainable production from the rough fescue prairie. J. Soil Water Conserv. 45:137-140.

Dormaar, J.F., S. Sandiak, and W.D. Willms. 1989. Vegetation and soil responses to short duration grazing on fescue grasslands. J. Range Manage. 42:252-256.

Dykersterhuis, E.J. 1949. Condition and management of rangelands based on quantitative ecology. Journ. Range Manage. 2:104-115.

Epp, H.T. 1993. Original range managers: migrant and sedentary grazers. Pp 47-59 *in* Proceedings - First Interprovincial Rangeland Conference, Jan. 17 - 21, Saskatoon, SK

Hill, M.J., W.D. Willms, D.J. Major and J.R. King. 1995. Modelling the Biogeography of Rough fescue in Alberta. Proc. Fifth International Rangeland Congress. Salt Lake City, Utah. pp 234-235.

Gauch, H.G. 1982. Multivariate analysis in community ecology. Cambridge University Press, Cambridge, 298 pp.

Johnston, A. 1961. Comparison of lightly grazed and ungrazed range in fescue grassland of southwestern Alberta. Can. J. Plant Sci. 41:615-622.

Johnston, A. 1962. Effects of grazing intensity and cover on the water-intake rate of fescue grassland. J. Range Manage 15: 79-82.

Johnston, A., J.F. Dormaar and S. Smoliak. 1971. Long-term grazing effects on Fescue Grassland soils. J. Range Manage 24:185-188.

Kjearsgaard, A.A., Jajek, J., Pettapiece, W.W., and McNeil, R.L., 1986. Soil Survey of the County of Warner, Alberta. Alberta Institute of Pedology Report No. S-84-46, 1984. Research Branch, Agriculture Canada, Edmonton, Alberta.

LandWise Inc., 1998. Soil series and Soil Landscape Model correlation for SCAs 1, 2, 3, 4, 5, 6, 8 and 16. Prepared for Alberta Public Lands. Lethbridge, Alberta.

LandWise Inc., 2001. Range Site - Soil Series and Soil Landscape Model Conversion for Soil Correlation Areas (SCA's) 7, 9 and 10. Prepared for Alberta Public Lands. Lethbridge, Alberta.

Looman, J. 1969. The fescue grasslands of western Canada. Vegetation, 19: 128-145.

Looman, J. 1982. Grasslands of Western North America: Fescue Grasslands. In Grassland Ecology and Classification Symposium. June 1982, Kamloops B.C.. Edited by A.C. Nicholson, A.
McLean and T.E. Baker. British Columbia Ministry of Forests. 353pp.

Mapfumo, E, W.D. Willms and D.S. Chanasyk. 2002. Water quality of surface runoff from grazed fescue grassland watersheds in Alberta. Water Qual. Res. J. of Can. 37:543-562.

Mapfumo, E., D.S. Chanasyk, and W.D. Willms. Modeling daily soil water under Foothills Fescue grazing with the Soil and Water Assessment Tool model. (Submitted for publication)

MacMillan, R.A., 1987. Soil Survey of the Calgary Urban Perimeter. Alberta Soil Survey Report No. 45. Alberta Research Council, Terrain Sciences Dept., Bulletin No. 54. Edmonton, Alberta.

McNeil, R.L., 2003. Ecological/range sites and potential plant communities of southern Alberta, derived from AGRASID 3.0. Prepared by LandWise Inc. for the Integrated Resource Management Branch, Alberta Environment.

Moss, E.H. and J.A. Campbell. 1947. The fescue grassland of Alberta. Can J. Res. 25:209-227.

Mueggler, W.F. and W.L. Stewart. 1980. Grassland and shrubland habitat types of Western Montana. Intermountain Forest and Range Experiment Station. USDA Forest Service General Technical Report INT-66: 154 pp.

Naeth, M.A., Pluth, D.J., Chanasyk, D.S., Bailey, A.W., Fedkenheuer, A.W., 1990. Soil compacting impacts of grazing in mixed prairie and fescue grassland ecosystems of Alberta. Can. J. Soil Sci. 70:157-167.

Naeth, M.A., A.W. Bailey, D.J. Pluth, D.S. Chanasyk, and R.T. Hardin. 1991. Grazing impacts on litter and soil organic matter in mixed prairie and fescue grassland ecosystems of Alberta. J. Range Manage. 44:7-12.

Robertson, C., and Hendry, M.J., 1982. Bedrock lithology of the southern plains of Alberta. Alberta Agriculture, Lethbridge, Alberta.

Robertson, A. and B.W. Adams. 1990. Two worksheets for range vegetation monitoring. Range Notes Issue No. 8 February, 1990. Pub No. T/207. Alberta Forestry, Lands and Wildlife, Public Lands Division, Edmonton,11pp.

Shetsen, I., 1987. Quaternary Geology, Southern Alberta. 1:500,000. Alberta Research Council, Terrain Sciences Dept. Digital version is available for $20.00 from the Alberta Geological Survey, email EUB.AGS-Library@gov.ab.ca.

Smoliak, S., J.A. Campbell, A. Johnston and L.M. Forbes. 1966. Guide to range condition and stocking rates for Alberta grasslands. Alberta Lands and Forests Publ. 27 pp.

Task Group on Unity in Concept and Terminology. 1995. New concepts for assessement of rangeland condition. J. Range Manage. 48:271-225.

Thompson, W.H. and P.L. Hansen. 2002. Classification and management of riparian and wetland sites of the Alberta Grassland Natural Region and adjacent subregions. Bitterroot Restoration, Inc. Prepared for the Alberta Riparian Habitat Management Program-Cows and Fish, Lethbridge. 416 pages.

Turchenek, L.W., and Fawcett, M.D., 1994. Soil Survey of the Municipal District of Rocky View No. 44, Alberta. Alberta Soil Survey Report No. 53. Alberta Research Council, Environmental Research and Engineering Dept., Edmonton, Alberta.

Walker, B.D., Brierley, J.A., and Coen, G.M., 1991. Soil Survey of the Pincher Creek - Crowsnest Pass Area, Alberta. Alberta Soil Survey Report No. 50. Agriculture Canada, Research Branch, Land Resource Research Contribution No. 88-04. Alberta Institute of Pedology Publication No. S-91-50. Edmonton, Alberta.

Walker, B.D., and Pettapiece, W.W., 1996. Soils of the Gleichen area, 82I/SW. Alberta Soil Survey Report No. 82I-SW. CLBRR Contribution No. 96-14. Agriculture and Agri-Food Canada Centre for Land and Biological Resources Research, Alberta Land Resource Unit, Edmonton, AB.

Willms, W.D., A.W. Bailey, and A. McLean. 1980. Effect of clipping or burning on some morphological characteristics of Agropyron spicatum. Can. J. Bot. 58:2309-2312.
Willms, W.D., S. Smoliak, and J.F. Dormaar. 1985. Effects of stocking rate on rough fescue grassland vegetation. J. Range Manage. 38:220-225.

Willms, W.D., S. Smoliak, and A.W. Bailey. 1986. Herbage production following litter removal on Alberta native grasslands. J. Range Manage. 39:536-539.

Willms, W.D. 1988a. Response of rough fescue (Festuca scabrella) to light, water, temperature, and litter removal, under controlled conditions. Can. J. Bot. 66:429-434.24

Willms, W.D. 1988b. Forage production and utilization in various topographic zones of fescue grasslands. Can. J. Anim. Sci. 68:211-223.

Willms, W.D., J.F. Dormaar, and G.B. Schaalje. 1988. Stability of grazed patches on rough fescue grasslands. J. Range Manage. 41:503-508.

Willms, W.D., S. Smoliak, and J.F. Dormaar. 1990. Vegetation response to time controlled grazing on mixed and fescue prairie. J. Range Manage. 43:513-517.

Willms, W.D. 1991. Cutting frequency and cutting height effects on rough fescue and Parry Oatgrass yields. J. Range Manage. 44:82-86.

Willms, W.D. and J. Fraser. 1992. Growth characteristics of rough fescue (Festuca scabrella var. campestris) after 3 years of repeated harvesting at scheduled frequencies and heights. Can. J. Bot. 70:2125-2129.

Willms, W.D., B.W. Adams, and J.F. Dormaar. 1996. Seasonal changes of herbage biomass on the fescue prairie. J. Range Manage. 49:100-104.

Willms, W.D., and L.M. Rode. 1998. Forage selection by cattle on fescue prairie in summer or winter. J. Range Manage. 51:496-500.

Willoughby, M. 1997. Rangeland reference areas - Seven Mile Creek, Range Condition and Trend 1964-97. Alberta Environmental Protection, Land and Forest Services, 20 pp.

Wroe, R.A., S. Smoliak, B.W. Adams, W.D. Willms, and M.L. Anderson. 1988. Guide to brange condition and stocking rates for Alberta grasslands. Alberta, Forestry Lands and Wildlife Publ., 33p.

USDA. 1988. Range plant handbook. Reprint of original 1937 handbook. Dover Publications, New York. 809 pp.

Willoughby, M.G. 1992. Species diversity and how it is affected by livestock grazing in Alberta. Range Notes: Issue No. 13, Alberta Public Lands. Pub. No. T/207. 3 pp

Willoughby, M.G., M.J. Alexander and B.W. Adams. 2003. 5th approximation. Range plant community types and carrying capacity for the Montane subregion. Alberta Sustainable Resource Development, Edmonton, Alta. Pub. no. T/589 223pp.

APPENDIX 9.1 Ecological Range Site Definitions

Table 13. Ecological/range sites, with definitions and abbreviated AGRASID correlations. From McNeil (2003).

[Z]Ecological/ Range Site	Revised Definition	AGRASID 3.0 Correlation
Subirrigated (Sb)	Water table is close to surface during growing season, but rarely above.	Gleyed non-saline medium- to coarse-textured soils.
Riparian (Ri)	Zone most closely adjacent to stream and river channels. Also known as the lotic zone.	Any SLM with floodplain or stream channel landscape model (FP1,FP2, FP3, SC1-l, SC1-h, SC2, SC3or SC4)
Overflow (Ov)	Areas subject to water spreading and sheetflow. Typically on gentle inclines or terraces prone to stream overflow.	Inclined, low relief landscapes including fans and aprons; or soils developed on fans, aprons or terraces.
Wetland (WL)	Typically low-lying or depressional positions subject to occupation by water ranging from temporary to semi-permanent in duration. Also known as the lentic zone.	Non or weakly saline Gleysols or Organic soils. OR undifferentiated water bodies (ZWA) with any landscape model **except** W1, W2 or W3.
Clayey (Cy)	Clayey textured soils including silty clay, sandy clay, clay, and heavy clay. Generally >40% clay.	Fine- and very-fine-textured soil groups.
Loamy (Lo)	Includes loam, silt loam, silt, clay loam, sandy clay loam, and silty clay loam.	Medium- and moderately-fine textured soil groups.
Sandy (Sy)	Sandy-loam-textured soils.	Moderately coarse soil group.
Limy (Li)	Eroded or immature soils with free lime ($CaCO_3$) at the soil surface. Soil pH generally >7.5.	Eroded, Rego and Calcareous soils or subgroups.
Sand (Sa)	Loamy sand and sand soils, and not with a duned surface.	Very-coarse-textured soil group and not on duned landscape models.
Blowouts (BlO)	Areas with eroded surface pits reflecting the presence of abundant Solonetzic (hardpan) soils.	Dominant or Co-dominant Solonetzic Order Soils.
Choppy Sandhills (CS)	Loamy sand and sand soils with a duned land surface.	Very-coarse-textured soil groups with duned landscape models.
Thin Breaks (TB)	Areas with bedrock at or near the soil surface; largely vegetated. May include thin, eroded or immature soils on gentle to steep landscapes.	Landscape models I3m and I3h; OR layered, medium, or fine materials with mas pm of L6, L7, L8, L16, M5, or F5.
Shallow to Gravel (SwG)	Soil with 20 to 50 cm of a sandy or loamy surface overlying a gravel or cobble- rich substrate.	Layered materials denoted by mas pm (parent material) codes L4 or L5.

[Z]Ecological/ Range Site	Revised Definition	AGRASID 3.0 Correlation
Saline Lowland (SL)	Areas with negligible vegetation due to electrical conductivity (salts) and/or sodium adsorption ratio limitations.	Saline Regosolic or Saline Gleysolic series OR sodic Regosolic series.
Gravel (Gr)	Dominated by gravels or cobbles (>50% coarse fragments). May be covered by a mantle with few gravels, up to 20 cm thick.	Layered or coarse materials with mas pm codes L1, L17, L19, L21 or C1.
Badlands/ Bedrock (BdL)	Nearly barren lands with exposures of softrock or hardrock. Includes steep valley walls.	Specific Landscape Models I4h, I5.

[Z]Ecological/range sites are listed in order from most productive to least productive.

9.2 A Concise Guide to Assist Users of AGRASID

9.2.1 - AGRASID: SOIL LANDSCAPE MODELS

AGRASID 3.0 is the most recent version of the Agricultural Region of Alberta Soil Information Database (ASIC 2001). AGRASID is a digital compilation of soils and landscapes presented at a scale of 1:100,000.

The basic soil map unit of AGRASID is the Soil Landscape Model (SLM) (ASIC 2001). Soil Landscape Models include soil series codes, a unit number, and a landscape model (Figure 5). Soil series proportions in a polygon or SLM are either dominant (50 to 100%), co-dominant (30 to 50%), or significant (10 to 30%). The soil series code in SLMs in which one soil series is dominant are denoted with three-letter symbols. The soil series code in SLMs in which two or three soil series are co-dominant are denoted with four-letter codes, with the first two letters indicating the first co-dominant soil and the last two letters indicating the second co-dominant soil. For example, an SLM with the soil series symbols BZCT indicates a co-dominant Beazer (BZR, Orthic Black Chernozem) developed on glacial till and, Cardston (CTN, Orthic Black Chernozem) developed on fine glaciolacustrine parent material.

A soil model unit number between 1 and 21 following the soil series symbol generally indicates a significant component of a particular soil or soils (Table 14).

Examples of Soil Model Numbers Used in Soil Landscape Models

- A simple SLM with one dominant soil (BZR) is indicated as BZR1/U1l. The soil model number 1 indicates a relatively pure unit with no significant identified soils. The landscape model U1l indicates a low-relief undulating landscape with slopes generally less than 2%.

- A complex SLM with two co-dominant soils (BZR and CTN) is indicated as BZCT2/U1h-c. The soil model number 2 indicates a significant proportion of wet soils (Gleysols or gleyed subgroups). The landscape model U1h indicates undulating topography (slopes of 2 to 5%). The c modifier refers to the presence of channels (Table 18).

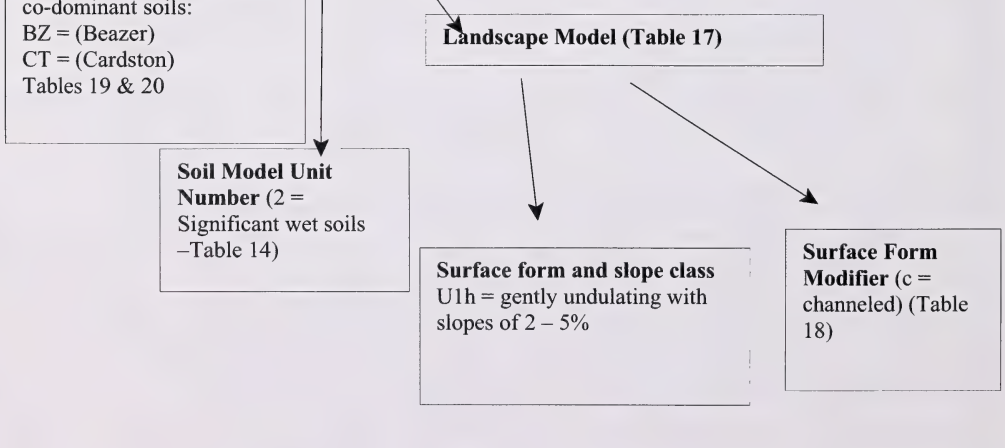


Fig. 5 An example of an SLM code.

9.2.2 SOIL MODEL UNIT NUMBERS

Table 14. Description of Soil Model Unit Numbers.

Soil Model Unit Number	Significant Soil	Additional Description
1	Relatively pure unit.	No significant soils identified.
2	Wet, including gleyed subgroups, Gleysols or Organics	Gleyed are imperfectly drained; Gleysols and Organics are usually poorly or very poorly drained
3	Saline or salt-enriched	Saline phase or Saline subgroups
4	Eroded, Rego or Calcareous	Eroded and Thin phases, Rego or Calcareous subgroups
5	Finer textured	Soils must be at least one textural group finer (refer to textural triangle, Fig. 4) than the dominant or co-dominant soils.
6	Coarser textured	Soils must be at least one textural group coarser (refer to textural triangle, Fig. 4) than the dominant or co-dominant soils.
7	Solonetzic order	hardpan layer affected by sodium enrichment
8	Wet (2) and Eroded, Rego and Calcareous soils (4)	Both Soil Model Units 2 and 4 are present in significant proportions
9	Wet (2) and coarser (6)	Both Soil Model Units 2 and 6 are present in significant proportions
10	Wet (2) and Solonetzic (7)	Both Soil Model Units 2 and 7 are present in significant proportions
11	Eroded, Rego and Calcareous soils (4) and coarser textured (6)	Both Soil Model Units 4 and 6 are present in significant proportions
12	Wet (2), Eroded, Rego and Calcareous (4) and coarser textured (6)	The three Soil Model Units 2, 4 and 6 are present in significant proportions
13	Significant saline soils (3) and eroded Rego and Calcareous soils (4).	Both Soil Model Units 3 and 4 are present in significant proportions
14	Eroded, Rego and Calcareous (4) and Solonetzic (7)	Both Soil Model Units 4 and 7 are present in significant proportions
15	Coarser textured (6) and Solonetzic (7)	Both Soil Model Units 6 and 7 are present in significant proportions
16	Chernozemic only if the dominant or co-dominant soils are Brunisolic, Luvisolic, Vertisolic, Regosolic, Solonetzic and/or Gleysolic	Significant Chernozemic soils in polygons dominated by soils of other orders.
17	Significant finer-textured soils (5) and significant Solonetzic soils (7).	Both Soil Model Units 5 and 7 are present in significant proportions
18	Wet (2) and finer-textured (5)	Both Soil Model Units 2 and 5 are present in significant proportions
19	Wet (2) and Chernozemic (16) only if the dominant or co-dominant soils are of a non-Chernozemic order.	Both Soil Model Units 2 and 16 are present in significant proportions
20	Imperfectly or freely drained soils (Gleyed subgroups) only if dominant or co-dominant soils are of the Gleysolic or Organic orders.	Dominantly poorly or very poorly drained soils, with significant non-Chernozemic soils that are either imperfectly or freely drained.
21	Dominant or two codominant Gleysolic soils with significant Organic soils.	Dominated by mineral wetland soils with significant areas of peat accumulation.

Variants

Variants of Soil Series are indicated as modifiers following the Soil Series code. Three examples are listed below. For a complete list of the 48 possible variants, see ASIC 2001.

co: Coarse-textured variation of the noted soil series. Textural class is at least one group coarser (Fig. 4). E.g., BZR is medium-textured, so a BZRco indicates at least a moderately-coarse-textured variation.

gl: Gleyed phase of the noted soil series. Soils are generally imperfectly drained, indicative of temporary wetlands. May also be indicative of a high watertable, which can promote subirrigation.

st: Stony phase used to indicate surface stoniness class of S3 or greater. Selected classes are defined in Table 15.

Table 15. Selected stoniness classes.

Stoniness Class	Description	% of Land Surface Covered By [Z]Stones or Boulders
S3	very stony	3 – 15
S4	excessively stony	15 – 50
S5	exceedingly stony	>50

[Z]Stones are 25 to 60 cm in diameter; boulders are >60 cm in diameter.

Undifferentiated Soil Models

Some soil landscapes are complex and may contain a wide variety of soil series. For these conditions undifferentiated soil models are used. Undifferentiated soil models begin with the letter Z, and reflect a broad grouping of particular soils that can include a soil order (E.g., ZSZ for Solonetzic), a soil subgroup (E.g., Gleyed is a component of ZGW), or a broad soil textural group (E.g., ZCO for coarse soils, Fig. 1). Nine undifferentiated soil models were used in AGRASID (Table 16).

Table 16. Description of Undifferentiated Soil Models.

Undifferentiated Soil Model Code	Description
ZCO	Coarse soils (gravel and sand)
ZER	Eroded mineral soils including Regosols and Rego and Calcareous subgroups
ZFI	Finer-textured soils (finer than indicated by series)
ZGW	Gleyed subgroups, Gleysols and water
ZNA	Saline soils
ZOR	Organic soils
ZSZ	Solonetzic order soils
ZUN	Undifferentiated mineral soils
ZWA	Water bodies

9.2.3 Landscape Models

Landscape Models reflect landform, surface shape, slope and relief. (Table 17). They are usually denoted with a capital letter followed by a number followed by a small letter. For a complete listing of landscape models, please refer to AGRASID Version 3.0 (ASIC 2001). Landscape models pertinent to Organic soil areas are not included for Range Guides of the Grassland Natural Region.

Table 17. Definition of Selected Landscape Models.

Code	Definition of Landscape Model	Predominant Slope Range (%)
DL	Disturbed land, including communities and facilities.	
D1l	Low-relief longitudinal dunes.	2 – 9
D1m	Moderate-relief longitudinal dunes.	5 – 15
D1h	High-relief longitudinal dunes.	9 – 30
D2l	Low-relief parabolic dunes.	2 – 9
D2m	Moderate-relief parabolic dunes.	5 – 15
D2h	High-relief parabolic dunes.	9 – 30
FP1	Unconfined meander floodplain.	0 – 5
FP2	Unconfined braided channel.	0 – 5
FP3	Confined floodplain with or without low-level terraces.	0 – 5
HR2m	Moderate-relief hummocky and ridged.	5 – 15
HR2h	High-relief hummocky and ridged.	9 – 30
H1l	Low-relief hummocky.	4 – 9
H1m	Moderate-relief hummocky.	7 – 15
H1h	High-relief hummocky.	12 – 30
H5l	Low-relief hummocky draped moraine over softrock.	4 – 9
H5m	Moderate-relief hummocky draped moraine over softrock.	7 – 15
H5h	High-relief hummocky draped moraine over softrock.	12 – 30
I3l	Inclined, generally single slope landform, including fans and aprons.	2 – 9

Code	Definition of Landscape Model	Predominant Slope Range (%)
I3m	Inclined; generally single slope moderate-relief landform.	6 – 15
I3h	Inclined and steep; generally single slope high relief landforms with 0 to 10% exposed bedrock.	15 – 60
I4l	Inclined; generally single slope low-relief landforms with >10% exposed softrock.	2 – 9
I4m	Inclined; generally single slope moderate-relief landforms with >10% exposed softrock.	6 – 15
I4h	Inclined and steep; generally single slope high-relief landforms with >10% exposed softrock.	15 – 60
I5	Inclined steep with extensive failure slumps.	15 – 60
IUl	Combination of inclined and undulating; generally a wavy pattern of gentle slopes on an overall inclined landscape.	1 – 5
IUh	Combination of inclined and undulating to hummocky; generally a wavy pattern of gentle to moderate slopes on an overall inclined landscape.	3 – 9
L1	Level plain.	0 – 2
L2	Level closed basin (depression with raised edges).	0 – 2
L3	Level and terraced; not within modern stream channels.	2 – 5
M1m	Moderate-relief rolling, including multi-directional inclined slopes greater than 400 m in length.	6 – 15
M1h	High-relief rolling, including multi-directional inclined slopes greater than 400 m in length.	15 – 30
R2l	Low-relief ridged landscape.	2 – 5
R2m	Moderate-relief ridged landscape.	6 – 15
R2h	High-relief ridged landscape.	12 – 30
SC1-l	Steep-sided valleys with a confined floodplain; low relief.	1 – 9
SC1-h	Steep-sided valleys with a confined floodplain; high relief.	9 – 60
SC2	Incised stream channel in wide valley with one or more terraces.	2 – 60
SC3	V-shaped valley with no terraces or floodplain.	2 – 60
SC4	Intermittently incised subglacial stream channel; partially infilled with glacial deposits.	2 – 60
U1l	Gently undulating or wavy pattern.	0.5 – 2
U1h	Undulating or wavy pattern.	2 – 5
W1	Channels, sloughs and ponds in a linear arrangement.	0 – 1
W2	Sloughs in a non-aligned aggregation.	0 – 1
W3	Level basin that may be filled or partially filled with water. Semi-permanent to permanent water body.	0 – 1

Landscape models sometimes include the following surface form modifiers (Table 18).

Table 18. Surface Form Modifiers.

Surface Form Modifier Code	Description
c	Channeled or rilled due to water erosion. Includes narrow and shallow temporary watercourses. Used when four or more channels occur within a cross-sectional distance of 800 m.
d	Dissected or gullied due to water erosion. Includes narrow to wide deep watercourses that interfere with ground transportation.
e	Eroded pits. Areas with more than 40% blowouts.
n	Concave or basinal water collection areas affected by surface water collection and/or groundwater discharge.
r	Shallow to bedrock. Bedrock is 1 to 5 m below ground surface

9.2.4 LISTING OF SOIL SERIES FOR THE FOOTHILLS FESCUE (SCAs 5 & 6)

Soil series are defined on the basis of detailed features of the soil pedon, such as colour, lithology, texture, and structure. Soil series reflect a unique combination of a soil subgroup and parent material that is present over a representative land area. Soil series are named for geographic points (e.g. towns) located in the area where they occur, and each soil series is denoted with a three-letter symbol. Soil series descriptions include soil subgroup, texture (Fig. 4) and parent material. A change in any of the three properties can result in a new soil series if there is sufficient area mapped in its applicable Soil Correlation Area.

Table 19. Soil Series of SCA 5. Black soils of southwest Alberta; Foothills Fescue South.

Soil Order and/or Great Group	Soil Subgroup	Parent Material, Surface Expression, Texture											
		Softrock	Till		Lacustrine			Glaciofluvial					Eolian
		All types	Veneer over softrock	Blanket	Blanket		Veneer over glacio-fluvial	Slope-wash	Blanket		Veneer over gravels	With gravels	Blanket, Del Bonita Plateau
		Medium	Mod. fine over all types	Mod. fine	Fine	Medium to mod. fine	Medium over very coarse	Medium to fine fluvial	Medium or mod. coarse	Gravelly medium	Medium fluvial over very gravelly very course	Gravelly very coarse	Medium loess
Black Chernozemic	Orthic	Owendale **OWD**	Ockey **OKY**	Beazer **BZR**	Cardston **CTN** [Z]Pincher **PNR**	Standoff **SOF**	Sakalo **SAK**	[Y]Hillmer **HLM** Shandor **SND**	[X]Knight **KNT** Lonely Valley **LVY**	Rockford **RFD**	**Blackfoot BFT**	**Rinard RND**	Del Bonita **DLB**
	Rego			Parsons **PSO**		Oldman **ODM**							
	Calcareous				Cowley **CWY**								
	Solonetzic					Bullhorn **BUL**							
Brunisolic	Orthic Eutric			North Fork **NFK**									
Black Solonetzic	Solod				Crowlodge **CGE**								
	Solodized Solonetz			Ninastoko **NNK**	Peigan **PGN**								
	Solonetz	Oxley **OXY**		Mami **MAM**	Klemengurt **KGT**								
Regosolic	Orthic	Mokowan **MKN**											
Gleysolic	Rego Humic				Joanto **JAT**								

[Z] **PNR is fine-textured non-stony glaciolacustrine. All others in the fine column can be slightly stony and may be associated with lacustro-till.**
[Y] **HLM is medium-textured fluvial slopewash confined to the Del Bonita Plateau. SND is fine-textured fluvial slopewash that can occur in any Ecodistrict of SCA 5.**
[X] **KNT is a stony moderately coarse-textured glaciofluvial, and LVY is also moderately coarse, but non-stony.**
[W] **NFK is medium-textured till.**

Table 20. Soil Series of SCA 6. Black soil zone of southwest Alberta; Foothills Fescue North

Soil Order and/or Great Group	Soil Subgroup	Parent Material, Surface Expression, Texture									
		Till Blanket	Lacustrine				Glaciofluvial				Fluvial- Eolian Blanket
			Blanket		Veneer over till		Blanket		Veneer over till	With gravels	
		Mod. fine	Fine to very fine	Medium to mod. fine	Fine over mod. fine	Medium to mod fine	Moder-ately coarse	Mod. fine over very gravelly very coarse	Mod. coarse over mod fine	Very coarse	Very gravelly very coarse	Very coarse
Chernozem	Orthic	[Z]Academy **ADY** Delacour **DEL**	[Y]Three Hills **THH**	Lyalta **LTA**		Rockyview **RKV**	Midnapore **MDP**	Rosebud **RSB**			Bow Valley **BOV**	Ardenode **ARE**
	Rego	Nose Creek AA **NSKaa**				East Bow **EBO**			Happy Valley **HPV**	Highwood **HIW**		
	Solonetzic		[Y]Twining **TWG**									
	Gleyed, Carbonated and Saline					[X]Kathyrn **KYN**						
Solo-netz	Solodized Solonetz	Beddington **BED**										
	Gleyed Solodized Solonetz					Keoma **KEO**						
Gleysol	Orthic Humic Saline						Gayford **GAY**					
	Humic Luvic	Indus **IND**										
	Rego Humic Saline				Balzac **BZC**							
	Rego Humic Carbonated				DeWinton **DWT**							

[Z]**ADY is a till with high lime content, and DEL is till with normal lime content.**
[Y]**THH is very fine-textured, and TWG is fine-textured.**
[X]**KYN is Gleyed with a veneer of moderately fine-textured glaciofluvial over moderately fine-textured till.**

Appendix 9.3

Table 21. Outlier communities are those sites which are unclassified due to small sample size or insufficient data.

OUTLIER COMMUNITIES IN THE FOOTHILLS FESCUE SUB-REGION								
Community	Number of Sites	*Ecodistrict	*Slope	*Drainage	*Range Site	*Landform Element	*Aspect	*Grazing Intensity
NATIVE OUTLIER COMMUNITIES								
Cow Parsnip	1	BLA	very gentle, gentle, moderate slope	UNDM.	N/A	UNDM	N	M
Foothills Rough Fescue-Bluegrass	6	BLA,DEL	strong, very gentel, nearly level, moderate slopes	WD, UNDM.	Lo, Cy	mid slope, UNDM, upper slope	SE, NE, NE-SW, E, UNDM	M, H, L, UNDM
Foothills Rough Fescue-Kentucky Bluegrass-Idaho Fescue	3	WLW,CAR	very gentle, gentle, UNDM	WD	Cy	terrace	S, SW, UNDM	UNDM, H
Foothills Rough Fescue-Parry Oat Grass	2	WLW	moderate slope	RD	N/A	crest, mid slope, upper slope	NW, UNDM	H, M
Foothills Rough Fescue-Sedge-Idaho Fescue	2	DEL	strong slope	UNDM.	Cy	upper slope, UNDM	UNDM	UNDM
June Grass-Pary Oat Grass-Foothills Rough Fescue	1	WLW	steep slope	WD	TB	crest, mid slope, upper slope	W	H
Kentucky Bluegrass-Alkali Bluegrass	2	CAR	level, nearly level, very gentle, gentle, moderate slopes, UNDM	WD	Lo	level deppression, lower slope, mid slope	UNDM	H
Needle and Thread Grass-Foothills Rough Fescue	1	WLW	UNDM	RD	SwG	terrace	UNDM	UNDM
Northern Wheatgrass-Foothills Rough Fescue	3	WLW	nearly level	RD	SwG	terrace	UNDM	UNDM
Parry Oat Grass-Foothills Rough Fescue	3	BLA	strong, very strong slope	RD,WD	Lo	UNDM	S ,W , SW	M, L
Parry Oat Grass-Foothills Rough Fescue/Silky Perenial Lupine	3	WLW	moderate, strong slope	RD	N/A	UNDM	S, N/NE, UNDM	L, M
Parry Oat Grass-Kentucky Bluegrass-Northern Wheatgrass	1	BLA	very gentle slope	UNDM.	SwG	crest	UNDM	M
Richardson Needle Grass-Foothills Rough Fescue	5	CAR,WLW	very gentle, moderate, level, nearly level, gentle, srtong slope	WD	Lo	mid slope, terrace	SE, E, UNDM	M
Salt Grass-Wheatgrass	1	END	UNDM	UNDM.	N/A	UNDM	UNDM	L, M
Smooth Brome-Common Yarrow	2	CAS, CAR	very gentle, gentle slope, UNDM	MWD, WD	N/A	level	W, UNDM	H, UNDM
Timothy-Foothills Rough Fescue	2	BLA	moderate, strong slope	RD, MWD	Lo	upper slope, mid slope, lower slope	E	M

Timothy-Kentucky Bluegrass/Graceful Cinquefoil-Dandelion	3	WLW,CAR	very gentle, gentle slope, level	WD	UNDM, Lo	terrace, level deppression, level, UNDM.	S, W-NW, UNDM	H, UNDM
Timothy-Kentucky Bluegrass-Foothills Rough Fescue	3	BLA	very gentle, gentle, very strong, nearly level	WD, RD, MWD	Lo, UNDM	lower slope, mid slope, upper slope, terrace	E	M, H
Western Porcupine Grass-Hooker's Oat Grass-Foothills Rough Festcue	3	WLW,BLA	strong, gentle slope, UNDM	RD,WD	TB, Cy, UNDM.	upper slope, lower slope, mid slope, terrace	SW, UNDM	M, UNDM
MODIFIED OUTLIER COMMUNITIES								
Crested Wheatgrass	1	CAR	very gentle, gentle slope	WD	N/A	level, lower slope	UNDM	H
Brome-Timothy	1	WLW	moderate, strong slope	RD	N/A	mid slope	SE	H
Kentucky Bluegrass/ Small-leaved Everlasting on cleared land	2	CAR	very gentle, gentle, moderate slope	WD	N/A	level, mid slope, upper slope	E-W, SW	H
Sedge-Northern Wheatgrass-Junegrass on cleared land	1	WLW	UNDM	WD	N/A	6	UNDM	H
Hairy Wild Rye on cleared land	1	CAR	strong, very strong slope	WD	N/A	mid slope	NE	UN-USED
SHRUB and FOREST OUTLIER COMMUNITIES								
Beaked Willow / Foothills Rough Fescue - Parry Oat Grass	1	BLA	strong slope	RD	Lo	lower slope, mid slope, upper slope	N	L
Buckbrush / Marsh Reed Grass	1	BLA	strong slope	RD	Lo	mid slope	E	L
Foothills Rough Festcue-Parry Oat Grass on shrubland	1	BLA	strong slope	MWD	Lo	lower slope, mid slope, upper slope	W	H
Hairy Wild Rye/ Lindley's Aster-Twinflower on treed wetland (mixedwood?)	1	WLW	very strong slope	WD	N/A	mid slope	W	M
Pinegrass-Hairy Wild Rye shrubland	1	WLW	UNDM	WD	N/A	mid slope, upper slope	N	M
Prairie Sedge-Quack Grass-Alkali Blue Grass on treed wet land	1	CAR	very gentle, gentle slope	WD	N/A	level deppression	UNDM	M
Saskatoon / Pary Oat Grass-Foothills Rough Fescue	1	BLA	strong slope	RD	Lo	crest, mid slope, upper slope	E	L

lists of details are in order of decreasing frequency unless separated by a dash (-), in which case they are equal. Only the major representatives are listed.
UNDM means that the details are undetermined for that site. *N/A in the range site category is due to format in which site was sampled and no range site was recorded.*